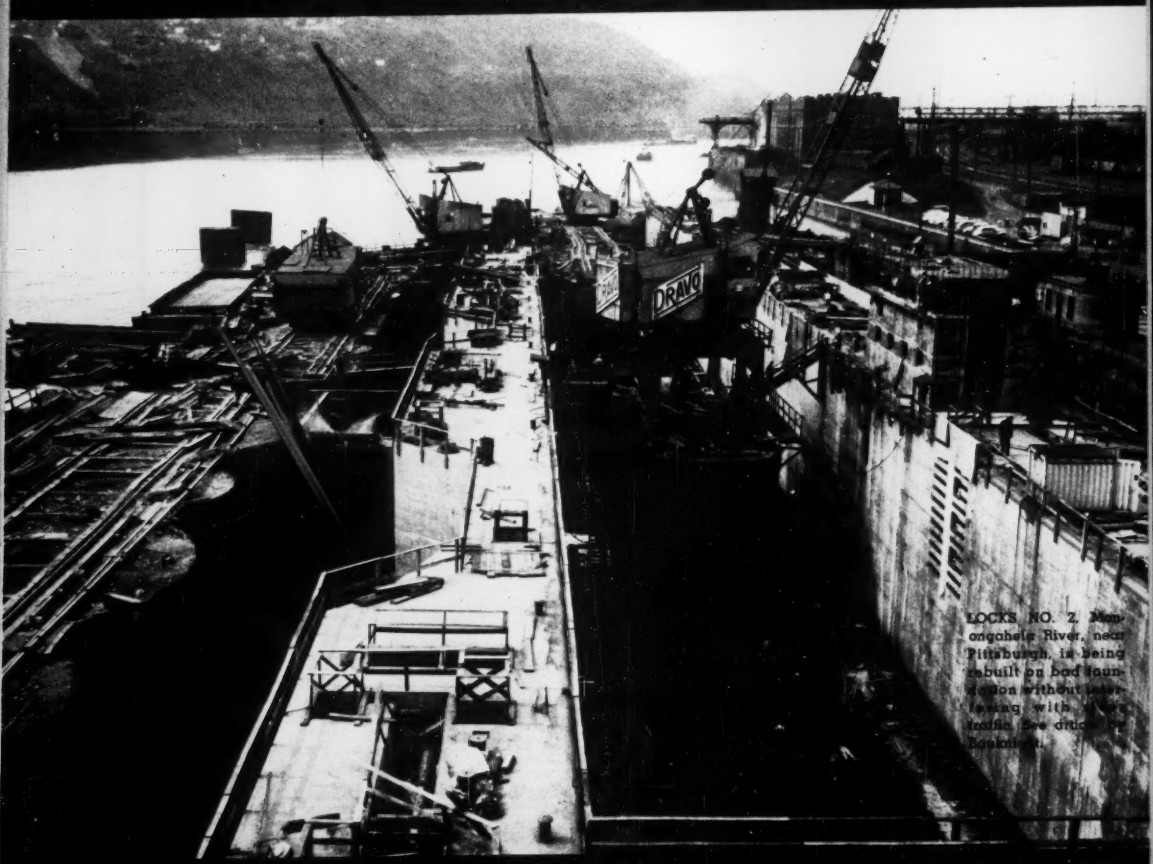
CIVIL ENGINEERING



LOCKS NO. 2, Monongahela River, near Pittsburgh, is being rebuilt on bed foundation without interfering with traffic. See article, Kaskaskia.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Raymond

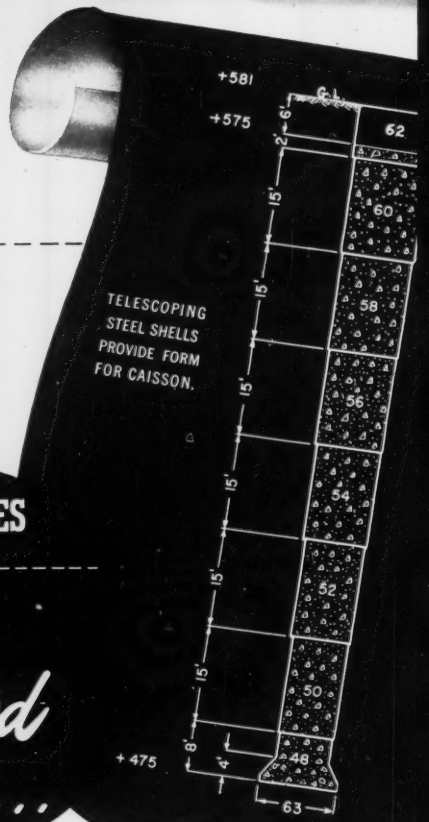
MAKES 5 TYPES OF CONCRETE PILES

1. STANDARD . . . 2. STEP-TAPER . . . 3. PIPE STEP-TAPER

4. COMPOSITE . . . 5. GOW CAISSONS

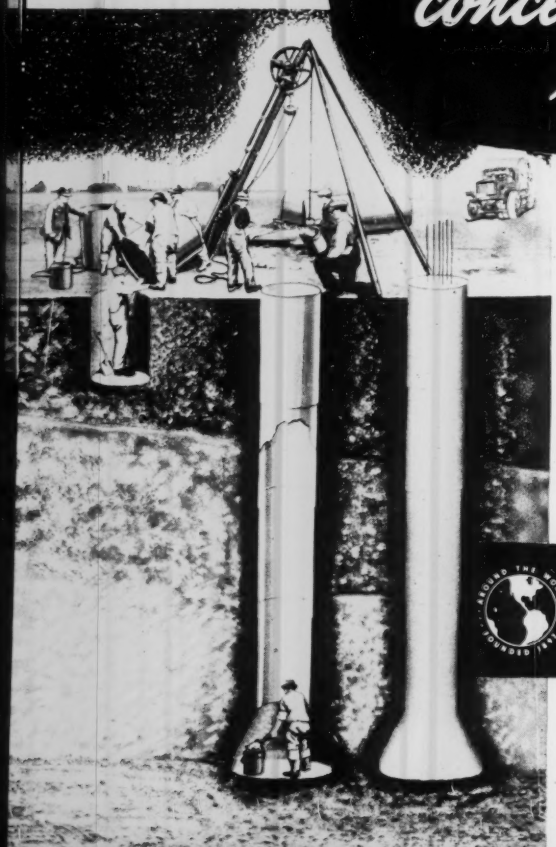
Raymond installs every type of pile: cast-in-place concrete, precast concrete, steel pipe, wood and H-beam. Raymond operations include underpinning, borings and soil investigations, waterfront construction and harbor and river improvements, and cement mortar lining of oil and water pipe lines 4" to 144" in diameter by the Centriline Corporation, a Raymond subsidiary.

At left, excavating starting pit and placing first cylinder. At center, excavating bell at bottom of the steel-lined shaft. At right, the completed caisson.



5. GOW CAISSON PILES

For heavy concentrated loads . . .



Raymond Gow caissons are efficient and economical for supporting heavy concentrated loads under certain soil conditions. The Gow method consists of hand or machine excavation carried on inside of telescoping steel cylinders. Where the caisson rests on hard ground, a bell is usually formed at the bottom to distribute the load over a large area. Where the caisson rests on rock, the bell is usually omitted. After excavation is completed, the steel cylinders are removed as the concrete is poured.

Because heavy equipment is not required and the steel cylinders are re-usable, Gow Caissons are economical in most soils. Your inquiry is cordially invited.

AROUND THE WORLD SINCE 1899

Raymond CONCRETE PILE CO.

140 CEDAR ST., NEW YORK 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America.

CHECK ALL THESE FEATURES . . .

. . . and you'll appreciate why there are more **LimiTorque®** *Automatic Valve Controls in use, than all others.*

1. **Micrometer torque seating switch.**
2. **Self contained unit—no gears, nut or bearings to buy.**
3. **Weatherproof, dust-tight and watertight construction.**
4. **Hammerblow device.**
5. **Non-rotating handwheel built into the unit.**
6. **Automatic declutching.**
7. **Motor is disengaged during handwheel operation.**
8. **Can always be declutched for handwheel operation regardless of weather or electrical conditions.**
9. **High torque motors.**
10. **Simple valve yoke.**
11. **May be mounted in any position.**
12. **Three to four times faster handwheel operation.**

This Unit is mounted on top of valve yoke . . . Stem nut is inside and furnished with LimiTorque Unit. Nut is directly inside worm gear which drives it. (All clutches and connecting sleeves are eliminated.)

The LimiTorque is designed for plug, butterfly, gate and globe valves up to 96″ diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.

A special high starting torque motor, reduction gears, limit switches are all in one weatherproof assembly—and all electrical connections are made to terminal boards, easily accessible by removal of watertight cover . . . heat treated helical gears and hardened, ground and polished worm and bronze worm gear are used.

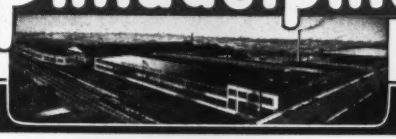
The usual Limitorque "hammerblow" device allows motor to reach full speed before load is engaged. This imparts the "hammerblow" necessary to unseat sticking valve.

Torque seating switch insures tight valve closure without strain on valve parts. Protection from damage due to a foreign object obstructing closing is provided during entire closing operation because motor is shut off by thrust exerted on valve disc.

Actuation may be by any available power source such as electricity, air, oil, gas or water.

Write for Catalog L-50 for complete details. Please use your Business Letterhead.

Philadelphia Gear Works, INC.



ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

CIVIL ENGINEERING, The Magazine of Engineered Construction, September, 1951. Vol. 21, No. 9. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

Concrete Frames and Floors

speed essential construction—economically

In carrying out its gigantic "project-a-month" program the New York City Housing Authority has demonstrated conclusively that when construction is designed with reinforced concrete frames and floors, construction time can be reduced. Time saved, of course, also means cost saved.

Marble Hill Houses is an excellent example. This huge project consists of eleven identical 14-story buildings with 1,400,000 sq. ft. of floor area. Eleven sets of forms, each used 14 times, made it possible to erect up to two stories per working day. In all, 154 floors and 11 roofs required only 123 working days (average of 1⅓ floors per day)—an accomplishment attained by engineering know-how, sound design and an experienced crew.

Photo shows a general view of the New York City Housing Authority's Marble Hill Houses under construction in the Bronx. The architect, John Ambrose Thompson; the structural engineer, Tuck & Eipel, and the general contractor, Cauldwell-Wingate Company, are all of New York City.

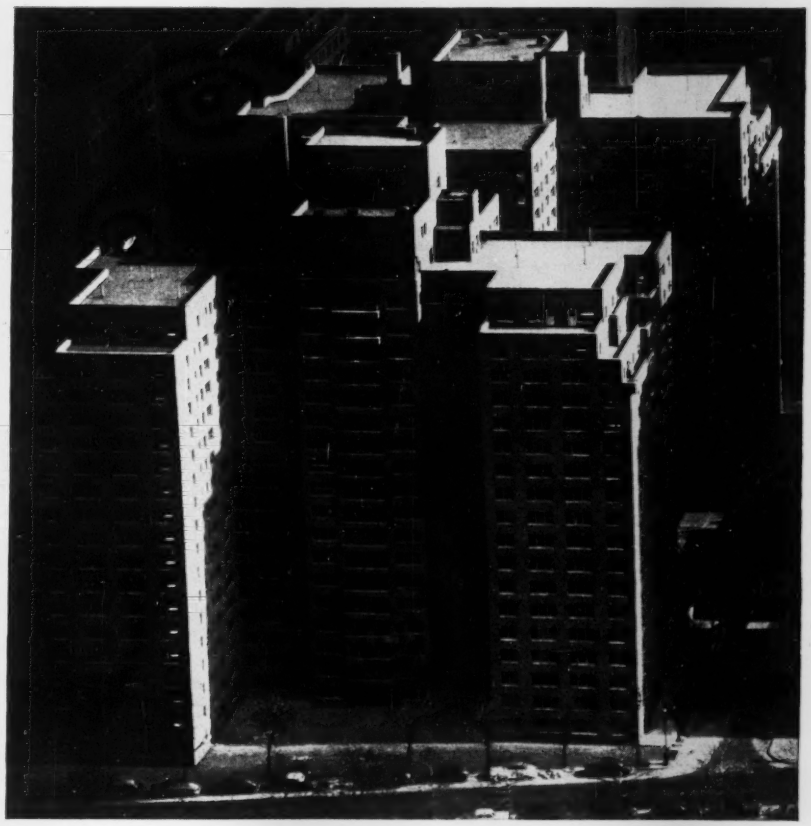
Concrete frame and floor construction has proved its speed and economy in all types of construction essential for defense—in tall structures as well as in buildings of six stories or less. It is ideal for hospitals, schools, industrial plants, apartments, public or office buildings.

Structurally, reinforced concrete frames and floors are sturdy, durable and firesafe. Economically, such construction makes possible substantial savings because it speeds work yet is (1) moderate in first cost, (2) requires little maintenance, (3) gives long years of service. The result is true ***low-annual-cost*** construction that makes concrete frames and floors a sound investment. Write for free literature. Distributed only in the U.S. and Canada.

PORTLAND CEMENT ASSOCIATION

DEPT. A9-13, 33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work



Schwab House, 651-family, 2200-room apartment building in New York City. *Builder and Owner:* 11 Riverside Drive Corp., Julius Perlbinder, President; *Renting and Managing Agents:* Herbert Charles & Co., Inc.; *Architect:* Sylvan Bien, New York; *Structural Engineers:* Weinberger & Weishoff, New York. Steel framework was fabricated and erected by Bethlehem.

Schwab House

High above the Hudson River in New York City stands Schwab House, an 18-story apartment building named for the late Charles M. Schwab, long recognized as the leader of the steel industry, and the founder of Bethlehem Steel.

Schwab House occupies the site of the former Schwab mansion, which for years was one of New York's landmarks. The structure is bounded by Riverside Drive, West End Avenue, West Seventy-third and Seventy-fourth Streets, and commands a sweeping view of the river, and of the busy West Side Express Highway.

Schwab House exemplifies modern living at its best. It has facilities for 651 families. It contains 2200 bright, cheerful rooms, and its apartment units vary in size from 1½ rooms to 5½ rooms. The structure includes penthouse apartments, terraces, restaurant, and two dance lounges. Its basement garage can accommodate 200 automobiles. It is serviced by a bank of 6 high-speed, gearless elevators.

The exterior of Schwab House is done tastefully in red brick and limestone, with large aluminum-framed windows, and covers a steel framework weighing 5322 tons, which was fabricated and erected by Bethlehem.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

FABRICATED STEEL CONSTRUCTION

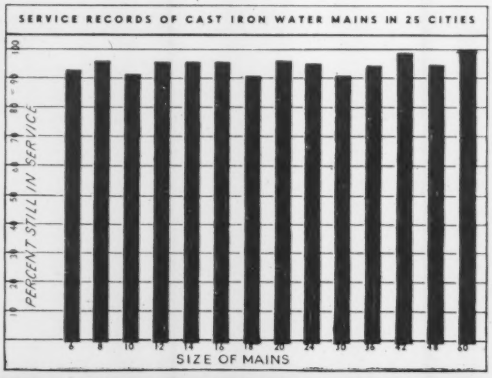
BETHLEHEM STEEL

No doubt about the stamina

Service Records of Cast Iron Water and Gas Mains
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
• Black dots represent original cast iron mains in service
★ Red stars represent cast iron mains in service 100 years or more

AMERICA PROVES IT! The above map shows cities having some or all of their *original* cast iron water or gas mains still in service. The red stars indicate 34 cities having cast iron water or gas mains in service that were laid a century or more ago.

SURVEYS PROVE IT! A recent study directed by 3 Water Works Associations shows that 96% of all cast iron water mains, 6-inch and over, *ever laid* in 25 representative cities, are still in service.



CAST IRON PIPE

of CAST IRON PIPE...

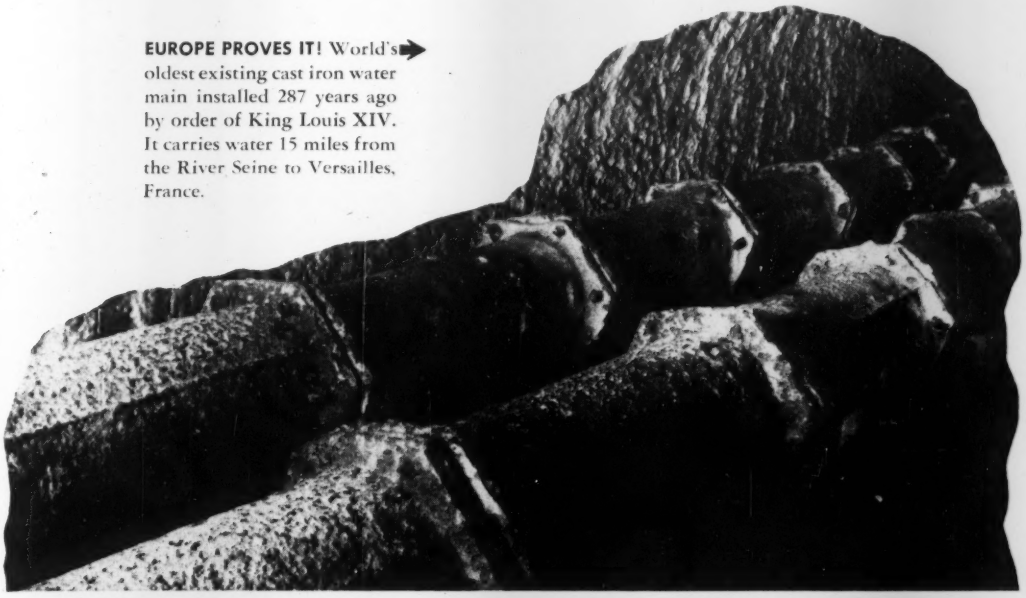
Europe proves it! The oldest cast iron water mains in the world, by authenticated records, supply the town and parks of Versailles, France. They were installed in 1664 and are still functioning after 287 years of service. Other cities in France, Germany and the British Isles have cast iron mains in service that are over 100 years old.

America proves it! Original cast iron mains are still serving 57 of America's largest cities. And 34 cities have either cast iron water or gas mains in service that were laid over 100 years ago (see map).

Surveys prove it! An exhaustive study, directed by a Joint Committee representing 3 Water Works Associations, shows that 96% of all cast iron water mains, 6-inch and over, *ever laid* in 25 representative cities, are still in service (see chart).

Yes, history proves beyond doubt that cast iron pipe has the stamina and the strength-factors that pipe must have to serve dependably under the paved streets of cities, towns and villages.

EUROPE PROVES IT! World's oldest existing cast iron water main installed 287 years ago by order of King Louis XIV. It carries water 15 miles from the River Seine to Versailles, France.



CAST IRON PIPE RESEARCH ASSOCIATION; THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

SERVES FOR CENTURIES

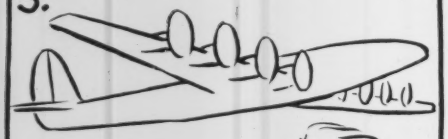
1.

What were the sharp-shooters of yesteryear?

2.

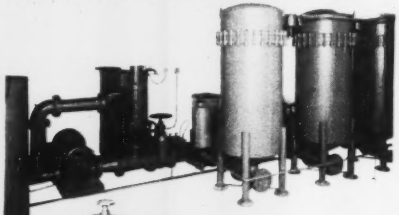
What were "big shots" at Gettysburg?

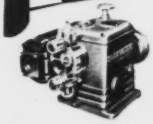
3.



What are "throwing their weight around" these days?

4. What make BOTH chemical feeders and diatomite filters?





Answer:

% PROPORTION %

Whether you "kill" your waterborne disease "enemies" with chemicals or "stop them dead" with filtration, %Proportioneers% is the best source for equipment to do the job. %Proportioneers% Chem-O-Feeder is well recognized for its versatility. You can use it for feeding hypochlorites, fluorides, coagulants, polyphosphates. The Pur-O-Cel Diatomite Filter, another important weapon against contamination, is so efficient it even filters out amoebic dysentery cysts.

Yes, %Proportioneers% is armed with the only "double-barreled shotgun" in the business. Mail coupon for complete details.

%PROPORTIONEERS, INC.%
360 Harris Avenue
Providence 1, Rhode Island

Please send me Bulletins SAN 7 and 1800.

Name .....

Company .....

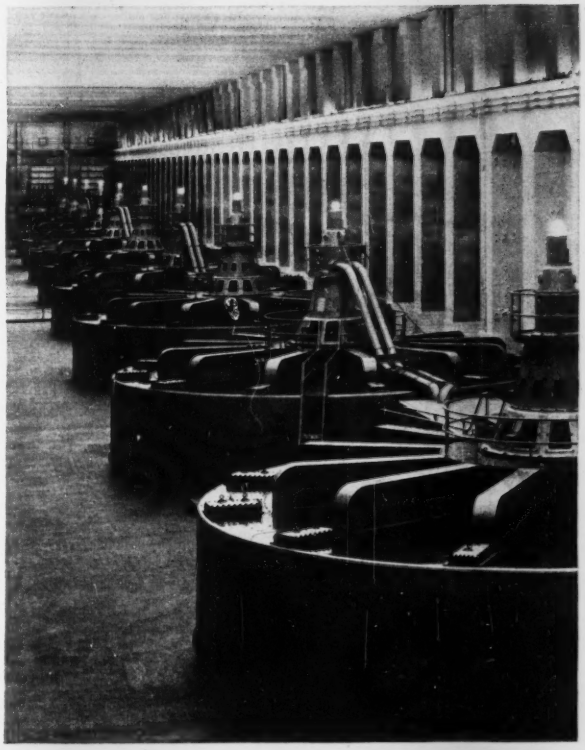
Street .....

City ..... State .....

Answers: 1. Fusileers 2. Cannoneers 3. Bombadeers

4. % PROPORTIONEERS, INC. %

The SMITH-KAPLAN TURBINE

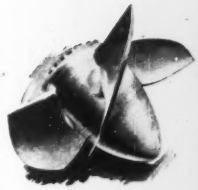


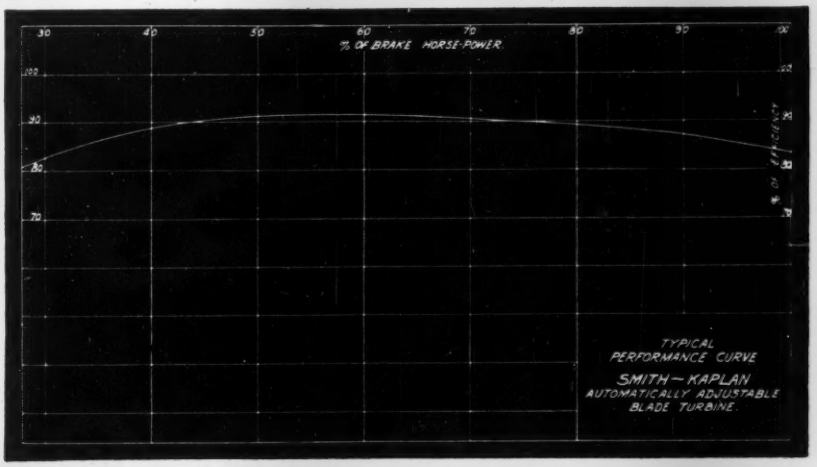
PROOF of value! - ten of these 75,000 Hp. units installed at Bonneville!

The Smith-Kaplan Turbine affords users high efficiency over a wide range of load, as a study of the accompanying Graph will reveal. Write for data.

If It's Hydraulics - Put It Up to Us!

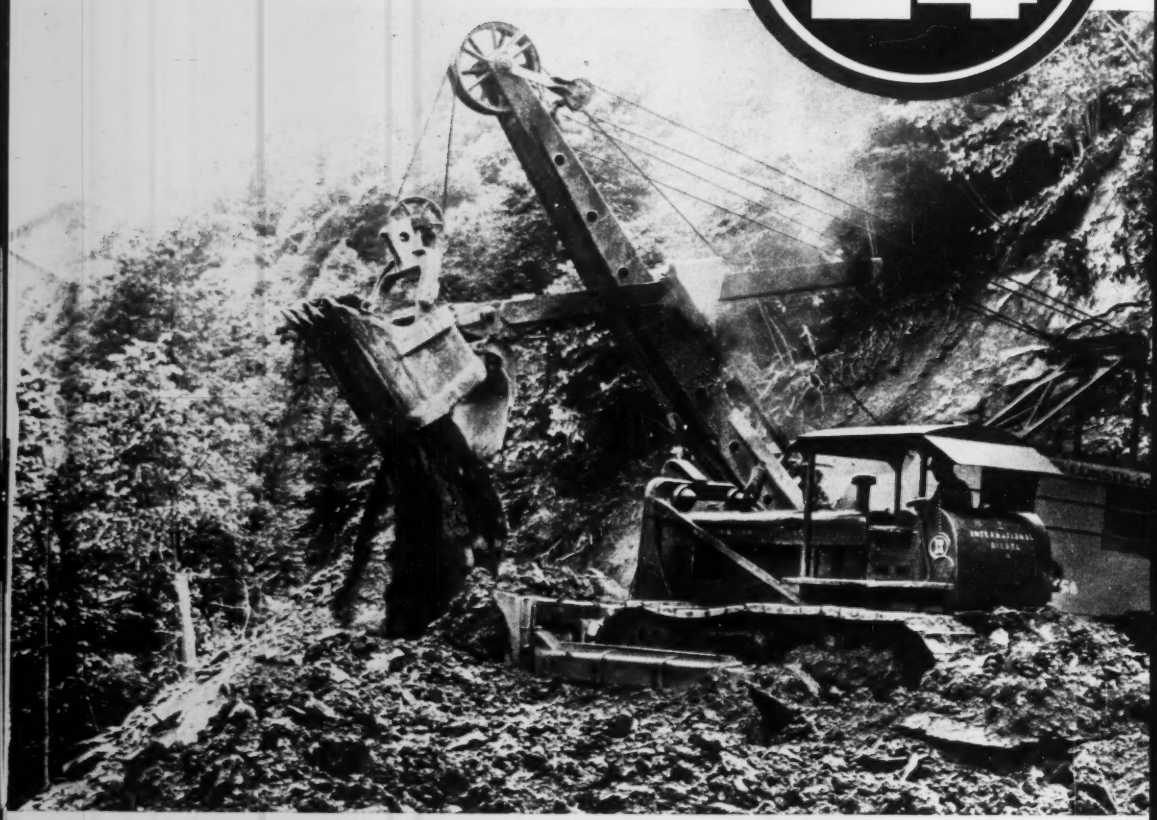
S·MORGAN SMITH COMPANY
·YORK · PENNSYLVANIA · U·S·A·





POWER by SMITH

Big Red TD 24



ANOTHER BIG BITE is dumped by the shovel and Big Red goes into action, grading the dirt down the hillside to carve out a workbench for the shovel. Teamwork is essential when shovel and tractor work together. And you always want Big Red on your team.

INTERNATIONAL

INTERNATIONAL HARVESTER

POWER THAT PAYS

Takes a Big Bite!

How International's Big Red Champ... the TD-24... Tackles 40 Feet of Solid Earth and Rock

Bring on your big tough jobs! Mass up the earth and rock. Then pass the word for "Big Red"—International's Champion of crawlers.

In the heart of the West Virginia mountains, Joe Troitino is stripping more than forty feet of earth and rock overburden to bare a rich four-foot seam of coal.

With the Big Red Champ on the job, Troitino strips about 450 tons of coal a day, and it's only one of his three coal stripping jobs!

"My company now owns six International TD-24s," says Troitino. "We think it is the best tractor on the market—and we have used all sorts of them under all kinds of conditions!

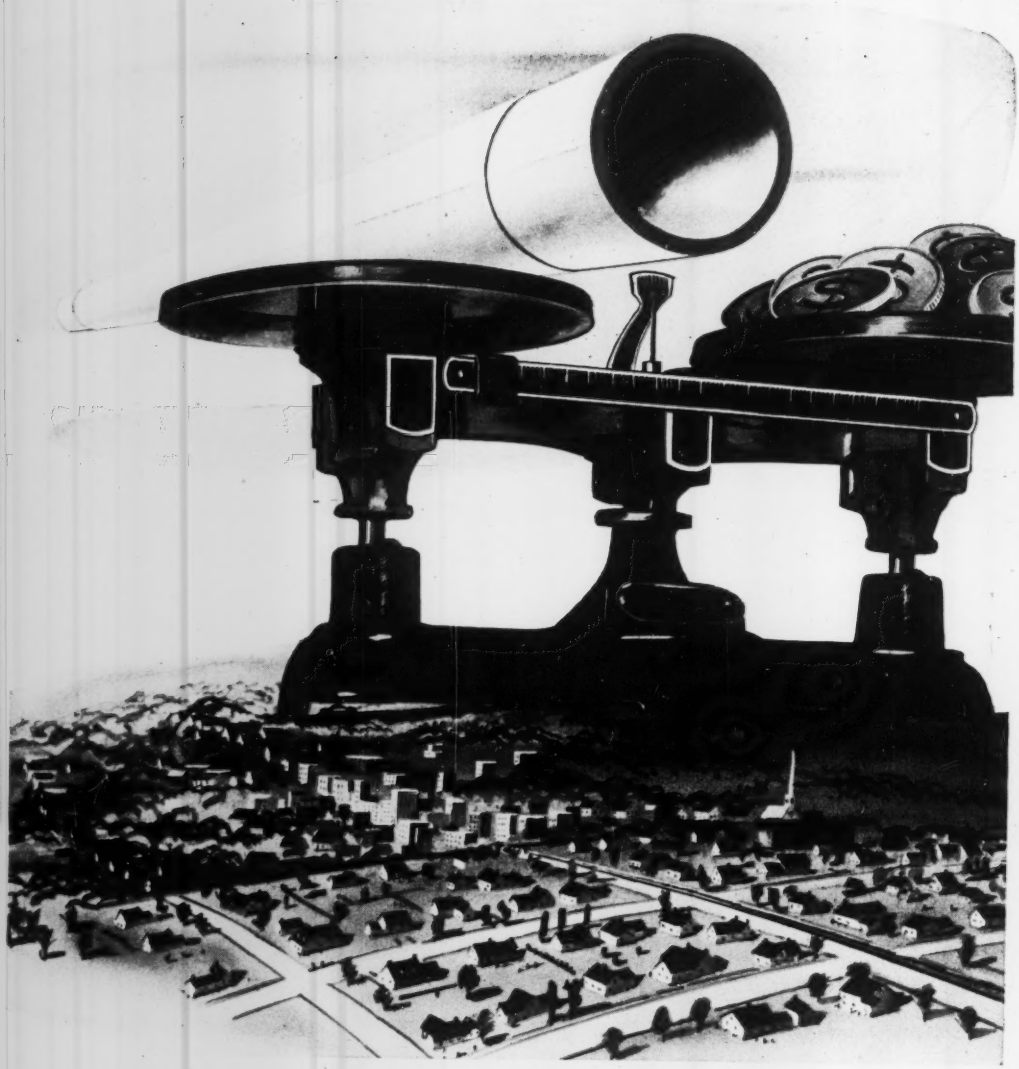
"Of course, I like the International TD-24 because it is easy to run, but, above everything else, we like it because it is more economical to operate than any other tractor we have ever used and because there is no rock or earthmoving job too tough for it."

The word is out. On the more rugged jobs, contractors who know crawlers are telling each other about the power and smooth action of the Big Red TD-24. Get the real low-down from your International Industrial Distributor. Ask him to show you Big Red in action—you'll be a TD-24 man from then on in!

International Harvester Company, Chicago 1, Illinois

IT TAKES THE CHAMP to pile into a drift of heavy dirt with the speed and drive needed to move it out of the way. Big Red and its big bites make passes fast, keep the load moving. With the TD-24 synchro-mesh transmission, instant high-low range shift and Planet Power steering, watch how the pay-dirt flies!

Worth its weight



JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

. . . in installation savings

Are you finding it increasingly difficult, in the face of today's economy, to undertake needed water-line construction?

If so, you may find—as other planners do—that Transite* Pressure Pipe can help provide a practical answer to your problem. For this pipe, in addition to its continuing, long-term savings, offers an opportunity for economies in installation *that may go far in helping you contend with rising costs and manpower shortages.*

Transite Pressure Pipe offers a combination of advantages which speed and facilitate water main installations all along the line—from the time the pipe is first received, to final placement of the line in service and restoration of normal street traffic. Not only do pipe laying crews find this modern pipe easy to work with, but its unique features make for a more compact, efficient and economical operation in virtually all the construction phases of water-line extension projects.

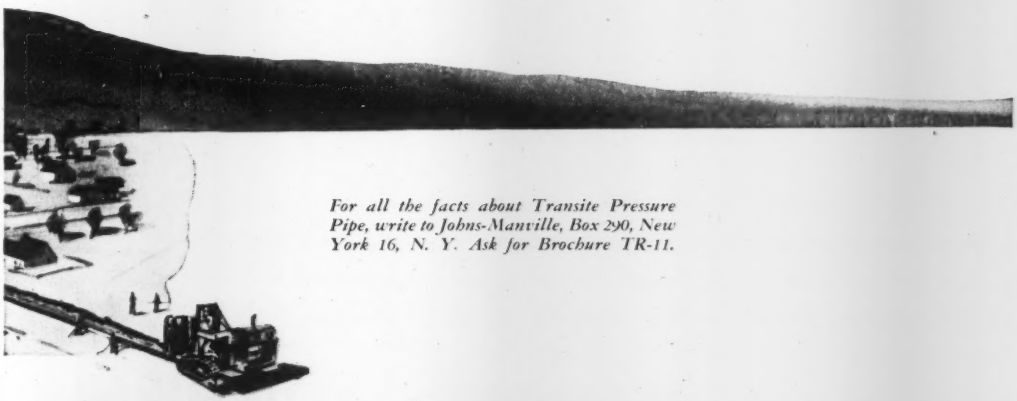
Economies start as soon as a shipment of Transite Pipe is received. Because it is light in weight, unloading and other handling operations are simplified. More footage can be carried per truckload, trucking costs are lowered, and distribution on the job site is faster. And except for the larger diameters of pipe, the sections can be lowered into the trench by hand, or with the aid of rope slings.

Assembly, too, is both rapid and economical. The flexibility of Transite's joints permit the pipe to be laid around wide curves without the need for special fittings. The Simplex Couplings require no calking or hot compounds; they are quickly and easily assembled to provide lastingly tight joints. *And with this pipe you can check for proper assembly immediately after the pipe ends are joined.*

Makes pipe-laying an assembly-line operation

This combined feature of rapid assembly and assurance of joint-tightness as fast as the line is laid, is the key to an important Transite advantage: it means that trench excavation, pipe laying, and backfilling operations can follow in quick succession—often under the supervision of one foreman. It makes pipe-laying virtually an assembly-line operation in which the trench can be closed in a minimum of time. This assures more economical use of excavation and earth handling equipment, reduces the expense and hazards of long stretches of open trench, and helps button-up the job with the least possible expenditure of time, labor and money.

These *initial* savings . . . plus the *long term* economies that have been effected in thousands of installations . . . are two good reasons why you should have the complete story about this modern asbestos-cement pipe developed and produced by Johns-Manville to carry water more efficiently and more economically.



For all the facts about Transite Pressure Pipe, write to Johns-Manville, Box 290, New York 16, N. Y. Ask for Brochure TR-11.

TRANSITE PRESSURE PIPE

* Transite is a registered Johns-Manville trade mark.

A.C.I. Building Code has been revised!

Now engineering designers can take full advantage of the steel savings and lower construction costs possible with the new A305 reinforcing bars. The American Concrete Institute has just recently revised its "Building Code Requirements for Reinforced Concrete" to utilize the improved bonding strength of the A305 bar. The new requirements permit higher bonding stresses with the A305 bar and practically eliminate hook anchorage. As a result, the revised code makes possible even more durable reinforced concrete structures at a lower cost.

However, before you can share in these benefits, your local code must be changed to conform to the new A.C.I. standards. Take action now, to have your code modernized!

1. Higher Bonding Stresses Permitted

Because A305 bars have higher, more closely spaced lugs than older bars, they provide a greater bond between steel and concrete. The code was changed to permit use of this improved bond.

2. Hook Anchorage Eliminated

Because of higher bonding strength, the need for end hooks is eliminated in practically all cases, and steel and fabrication costs are reduced.

3. Lapping Reduced

Higher bond strength also increases the efficiency of splices, reducing the steel required.

CONCRETE REINFORCING STEEL INSTITUTE

38 S. Dearborn St.
Chicago 3, Ill.

Does your local Code CONFORM?

On this highway job between Bardstown and Fredericktown, Ky., a 1¼-yd. Thew Lorain shovel, powered by a "Cat" D13000 Engine, loads heavy rock into Athey wagons, pulled by "Caterpillar" D7 Tractors. The contractor is W. C. Snyder, Danville, Ky.

There's a big job ahead

How your equipment stands up in the months ahead has a real bearing on America's fight to be strong and stay free. A vital part of that effort is the $12,000,000,000 worth of earthmoving and road building needed this year. And we're entering a period that will separate "the men from the boys" in the field of construction machinery.

Military needs and Defense Rated Orders are taking their share of "Caterpillar" production. Shortages of steel and other materials add to the difficulty of supplying the demand for new machines. This means that *present equipment must be kept in use.*

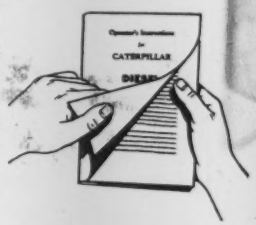
"Cat" Diesel Engines, Tractors, Motor Graders and Earthmoving Equipment are built with the stamina to serve you long and faithfully. But *how* long is up to you and the operation and maintenance you give them. Good care pays off.

You can add many hours to equipment life if you follow sound maintenance practices. Anticipate your parts needs *before* wear goes beyond repair. Talk it over with your "Caterpillar" dealer. He is qualified to give competent opinion. If a part is not readily available, he has the tools and knowledge to rebuild many worn parts — and keep your machinery on the job.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

You're the Doctor

Don't let your engine overheat. Maintain the cooling system, keeping it free of scale, rust and sediment. Use soft or treated water and, when freezing temperatures exist, protect your engine with anti-freeze. Clean the radiator periodically, removing foreign matter from the core by brushing or washing. Use chemical flushing solutions. Prevent engine troubles which come with overheating. Consult your Operator's Instruction Book.

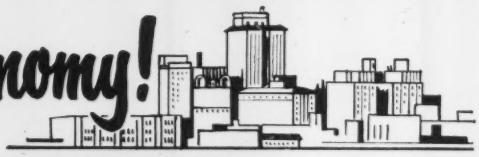


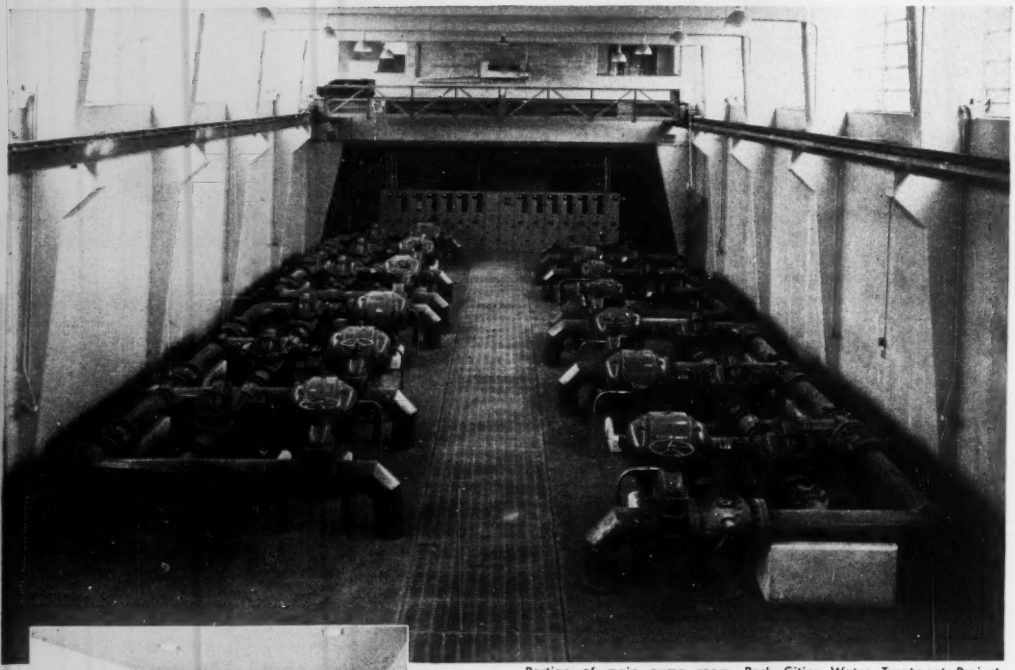
CATERPILLAR

REG. U. S. PAT. OFF.

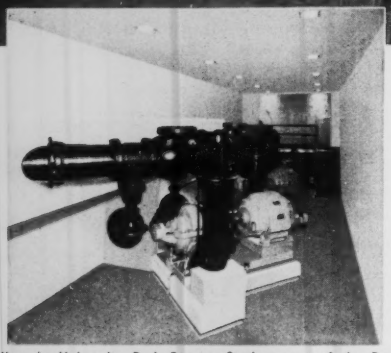
DIESEL ENGINES
TRACTORS
MOTOR GRADERS
EARTHMOVING EQUIPMENT

Now...Dallas Park Cities *are pumping with Economy!*





Portion of main pump room, Park Cities Water Treatment Project. Shown are 13 of the 22 Economy Pumps installed on this project.



View in University Park Booster Station, part of the Park Cities project. These Economy Pumps boost the pressure going to the overhead storage tank, located 5 miles from the treatment plant.

in new Park Cities, Texas, Water Treatment Plant

Economical operation over a period of years was a primary requisite of the pumps for Park Cities Water Treatment Project, Dallas. In selecting pumps, Powell & Powell, Consulting Engineers, drew up specifications which took into consideration cost of equipment, efficiency of each unit and efficiency of units operating in series, plus rigid structural requirements and refinements of mechanical detail. Under this very exacting evaluation formula, Economy Pumps, designed especially for water works service, supplied by the Lone Star Pump and Machinery Co., were selected, on the Dallas County project.

It pays to specify Economy Pumps for water supply. For detailed information and illustrated catalogs write today to Dept. BK-9.

Economy Pumps, Inc.

DIVISION OF HAMILTON-THOMAS CORP., HAMILTON, OHIO

in WIRE ROPE, too

It's all in the RIGHT KIND of Muscle

The powerful, rugged muscles of a charging rhino enable him to propel his tremendous bulk and weight at truly remarkable speed. Nature designed them well for the purpose they have to serve.

In wire rope, too, the right kind of muscle is vitally important... because different types of jobs present different types of destructive forces. Bending fatigue! Shock stress! Abrasion! Load strain! Each demands wire rope that best combines the required resistance characteristics.

Wickwire Rope gives you the benefit of long experience and specialized know-how which assures you of exactly the right kind of rope your particular job demands.

For additional information write or phone our nearest sales office.

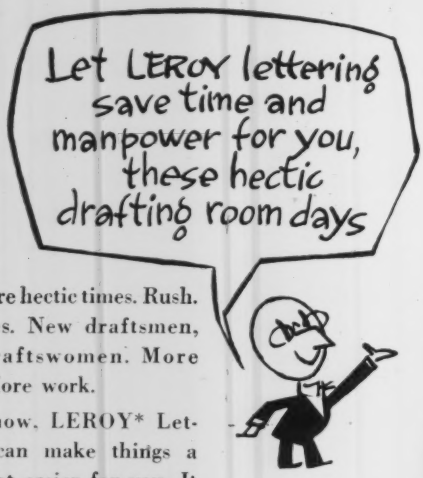
WICKWIRE ROPE
A CF&I PRODUCT

LOOK FOR THE YELLOW TRIANGLE ON THE REEL

EAST: WICKWIRE SPENCER STEEL DIV.—Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.) • Philadelphia • New York
WEST: THE COLORADO FUEL & IRON CORP.—Abilene (Tex.) • Denver • Houston • Odessa (Tex.) • Phoenix • Salt Lake City • Tulsa
PACIFIC COAST: THE CALIFORNIA WIRE CLOTH CORP.—Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane

WICKWIRE ROPE

CF&I PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL & IRON CORPORATION

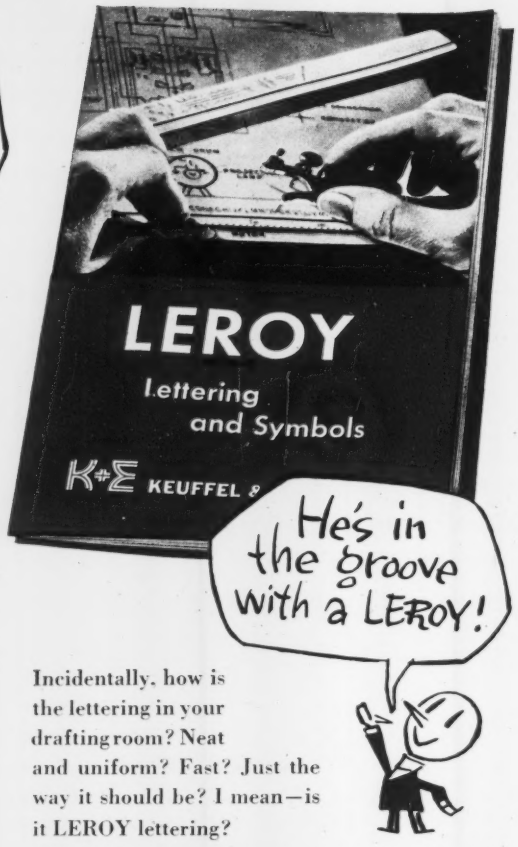


These are hectic times. Rush. Changes. New draftsmen, new draftswomen. More rush. More work.

You know, LEROY* Lettering can make things a whole lot easier for you. It takes almost no learning. Very little practice, and even the greenest draftsman can rattle it off like a blue streak, and as neatly as an old hand. One fellow can even carry right on without a break where the other left off.

THE MAN WHO HAND LETTERED THIS LINE

DID THIS WITH A LEROY LETTERING SET.



Incidentally, how is the lettering in your drafting room? Neat and uniform? Fast? Just the way it should be? I mean—is it LEROY lettering?

You can have LEROY alphabets and numerals in all sorts of sizes and styles—even in Greek, if you like. And LEROY symbols too, that save hours of work — electrical, welding, geological, mapping, mathematical—and all sorts of specials made to your own order.

I can't begin to tell you in this one page. But send for the free LEROY Book. It will tell you a lot you may not know.

*Trade Mark ®

KEUFFEL & ESSER CO.
HOBOKEN, N. J.

Please send me a free copy of your book about LEROY Lettering and Symbols Equipment.

Name_____

Firm_____

Street_____

City_____ Zone____ State_____

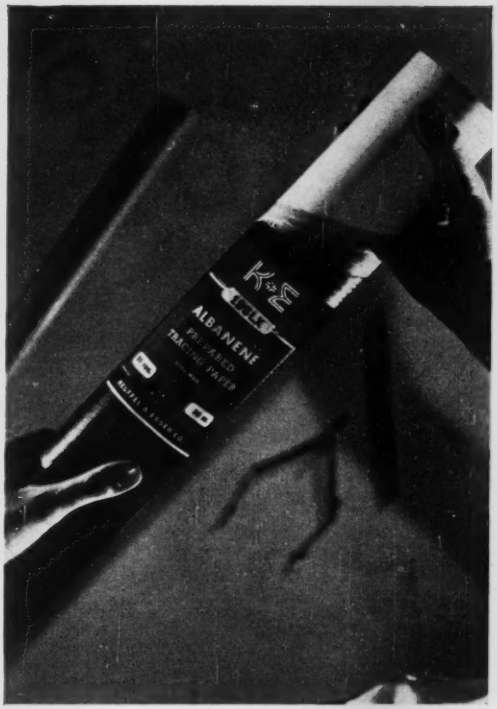
WHY ALBANENE* IS AMERICA'S No.1 TRACING PAPER

Do you know why ALBANENE holds up its record year after year as the No. 1 tracing paper on American drawing tables?

Can you remember back when K&E first put ALBANENE on the market years ago? It was the sensation of the drafting rooms. A paper transparentized without oils or wax. No more messy leaking. No spoiling of drawings in the files because the oil would run out from one to another.

No more loss of transparency and poor reproductions. No more aging, yellowing or turning brittle.

Yes, that was ALBANENE. Because ALBANENE was transparentized with something new and different, an inert, synthetic solid specially developed to do the job, a transparentizer that stayed put. The 100% long fiber, pure rag paper base was stabilized and transparentized through and through. Drawings made on ALBANENE back in those days are still as clear and crisp, just as good for reproductions, as the day they were drawn.



*Trade Mark ®

And that is exactly how ALBANENE is still being made today. The same fine quality base stock. The same fine oil-free transparentizer. All the same top qualities.

That's why ALBANENE is America's No. 1 tracing paper.

K&E
partners in creating
For 84 years K&E equipment and materials have been partners of the draftsman, engineer and scientist in shaping the modern world.

puts Worthington FIRST for Engines

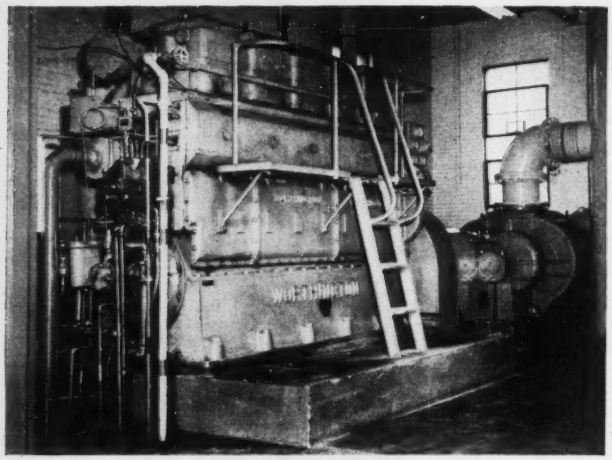
If there were such a book as "WHO'S WHO IN SEWAGE", we're sure Worthington would lead the list in engines sold and total hp in the larger size units.

Over its 17 years of experience in the field, sewage plants have purchased 106 Worthington units, with a total installed hp of 46,000.

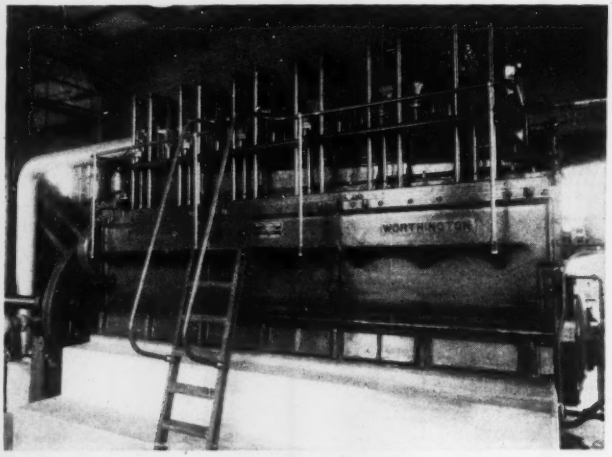
Worthington offers dual fuel or spark-ignition engines, atmospheric or supercharged, for blower, pump, generator or combination drive. All engines give you the economy and trouble-free performance that result from such Worthington features as:

- governor-controlled, balanced-plug type metering valves on each cylinder
- mechanically-timed gas injection valve on each cylinder
- automatic thermal air throttling control
- dual-plunger fuel pumps

For further information on engineering and application of engines in sewage plants, remember *there's more worth in Worthington* and consult with our nearest office. Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.



Phoenix, Arizona Sewage Department installed Worthington Dual Fuel Engines in 1949 to drive blowers.



Peoria, Illinois Sanitary District installed this Worthington Gas Engine in 1935 to drive blowers.

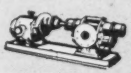
WORTHINGTON

E.17

ECONOMICAL CONTINUOUS POWER
Diesel Engines, 150 to 2640 hp
Gas Engines, 190 to 2880 hp
Dual Fuel Engines, 345 to 2640 hp

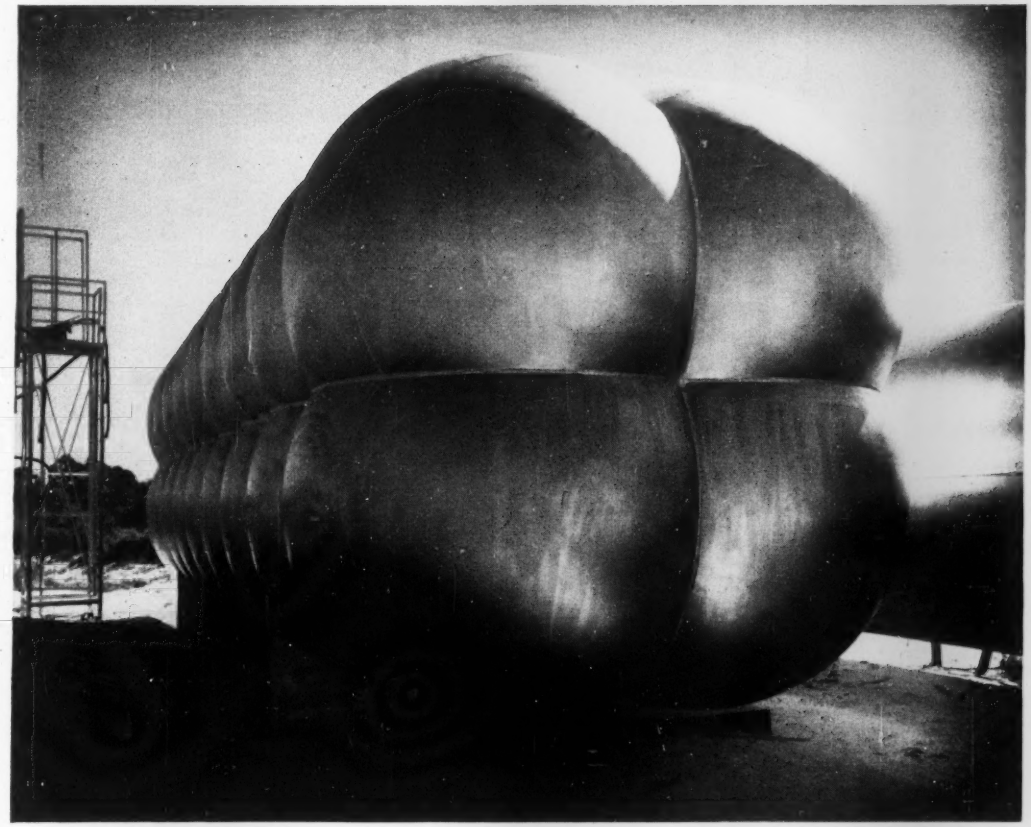
WORTHINGTON-BUILT AUXILIARIES

Balanced Angle Compressors


Oil Transfer Pumps

Cooling Water Circulating Pumps

Evaporative Type Engine Water Coolers



New Development in High Pressure Storage

The Horton Multisphere shown above is one of the most efficient developments in modern high pressure storage containers. It is designed to reduce the weight of the metal required to store liquids and gases under high pressure. It can also be built to fit into areas where space is limited, such as in buildings, barges, etc.

The Multisphere is made up of spherical steel sections with flat, internal steel diaphragms between them to take the component of stresses in the shell where the sections come together. When the Multisphere is subjected to internal pressure, both the shell and the diaphragms are stressed in equal, biaxial tension.

In order to successfully fabricate the Multisphere to withstand high internal pressures, there must be careful, accurate fitting and welding of the plates as each welded seam in the shell joins two spherical segments and the edge of an internal diaphragm. All internal joints in the diaphragms are three-way or four-way welds.

Tough as the job is, our years of experience in fabricating every kind of pressure vessel makes it possible for us to successfully create the Multisphere according to exacting specifications.

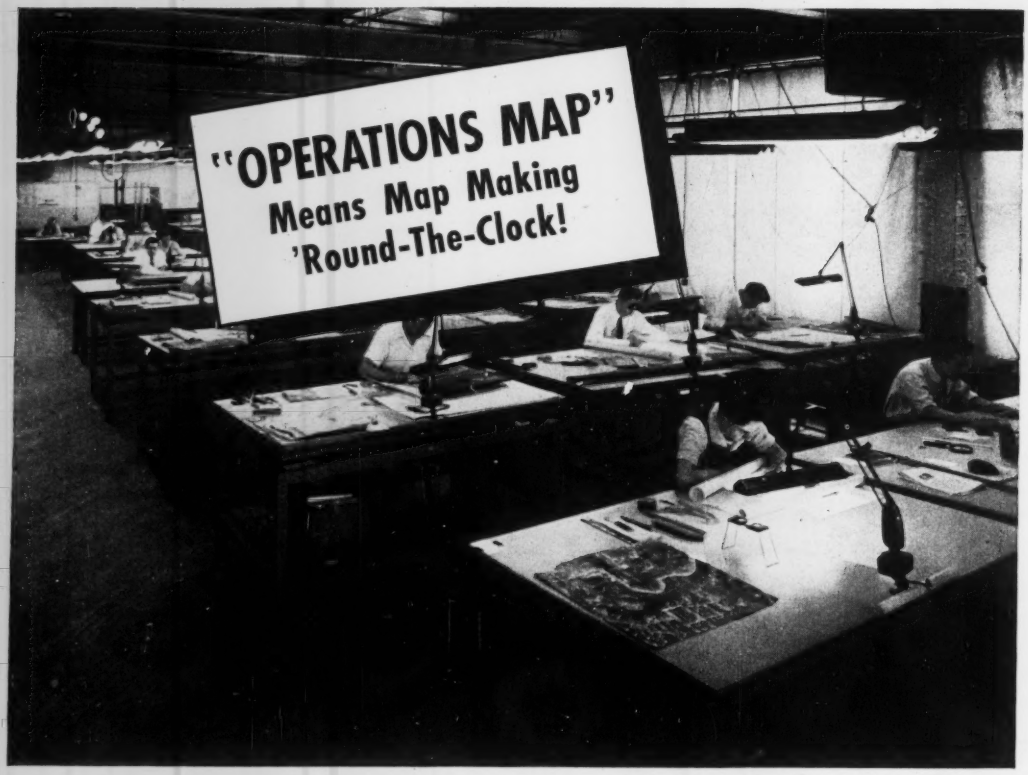
Utilize this experience when you need a difficult steel plate fabrication problem solved. Consult our nearest office for details today. There is no obligation on your part.

Above: 30,000-gallon Multisphere built for the Superior Dade Gas Corporation at Fort Lauderdale, Florida. The dimensions of this high pressure storage container are 11 ft. 6 in. by 11 ft. 6 in. by 34 ft. 8 in. It is designed to operate at pressures up to 250 lbs. per sq. in.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3	2167 Healy Bldg.	Detroit 26	1541 Lafayette Bldg.	Salt Lake City 4	509 West 17th South St.
Birmingham 1	1596 N. Fiftieth St.	Houston 2	2128 National Standard Bldg.	San Francisco 4	1584—200 Bush St.
Boston 10	1009—201 Devonshire St.	Los Angeles 17	1556 General Petroleum Bldg.	Seattle 1	1309 Henry Bldg.
Chicago 4	2199 McCormick Bldg.	New York 6	3395—165 Broadway Bldg.	Tulsa 3	1647 Hunt Bldg.
Cleveland 15	2263 Guildhall Bldg.	Philadelphia 3	1652—1700 Walnut St. Bldg.	Washington 6, D.C	1156 Cafritz Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.



TODAY, maps are needed in a hurry! Every day—every *hour* which speeds their delivery is important to the nation as it girds itself for the greatest production drive in history.

OPERATIONS MAP is the first phase of this new plant development program. It calls for aerial mapping, with its speed, high accuracy, and its ability to work a 'round-the-clock schedule.

That's why AERO is the center of all this activity. AERO's staff of more than 200 aerial mapping engineers deliver surveys weeks and *months* ahead of ground schedules. AERO mapping is not slowed by terrain . . . and the map compilation is not limited by daylight hours in the field. Under urgent conditions AERO mapping can go forward day and night.

And AERO produces maps of greater accuracy and with more detail than ground methods—good reasons why engineering firms rely on us to help speed their work. When AERO does the job, your own staff is available for other engineering projects.

Put your mapping problems in AERO's hands. We can fulfill your requirements—*often at half the cost of ground methods.*

TOPOGRAPHIC MAPS • PLANIMETRIC MAPS

PRECISE AERIAL MOSAICS • AIRBORNE MAGNETOMETER SURVEYS

RELIEF MODELS • COLOR PHOTOGRAPHY

AERO

SERVICE CORPORATION

PHILADELPHIA 20, PENNSYLVANIA

Oldest Flying Corporation in the World

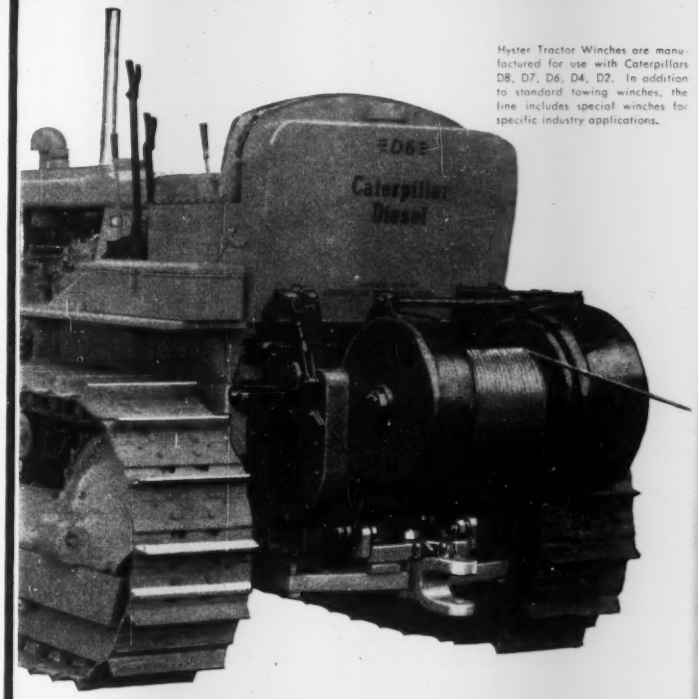
More than 40,000 satisfied owners of

HYSTER® *Tractor Winches*

Hyster Towing Winches increase tractor drawbar pull by as much as 63% when utilizing the maximum line pull of the winch. They are used to —

- ✓ **MOVE** heavy equipment.
- ✓ **RESCUE** heavy trucks or pieces of equipment that are mud-bogged.
- ✓ **PULL** the tractor itself out of mud or other situations that have incapacitated the tractor.
- ✓ **INSURE** against work stoppage or down-time on any project using equipment.
- ✓ **ASSIST** in stump and land clearing operations.
- ✓ **INCREASE** production in logging operations through the use of arch-logging methods.
- ✓ **GROUND SKID** or pan skid logs.
- ✓ **YARD** logs.
- ✓ **PERFORM** innumerable lifting jobs in conjunction with crane attachments.

Hyster's complete line of tractor tools includes winches, yarders, donkeys, cranes, logging arches and sulkies®; Grid Rollers for bituminous road salvage; and Hystaway®, the 5 in 1 tool that includes dragline, clamshell, crane, shovel and backhoe.



Hyster Tractor Winches are manufactured for use with Caterpillars D8, D7, D6, D4, D2. In addition to standard towing winches, the line includes special winches for specific industry applications.

HYSTER COMPANY

2999 N. E. Clackamas, Portland 8, Oregon
1899 North Adams Street, Peoria 1, Illinois

World's Largest Manufacturer of Tractor Winches

Sold and Serviced for more than 20 years by CATERPILLAR-HYSTER dealers all over the world

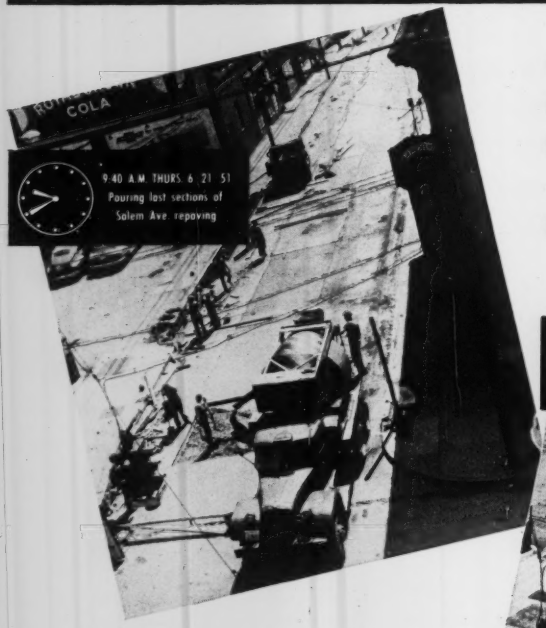
A high percentage of all Caterpillar Diesel tractors are equipped with Hyster winches.

Caterpillar dealers around the globe—more than 400—sell and service Hyster towing winches for Caterpillar-built tractors.

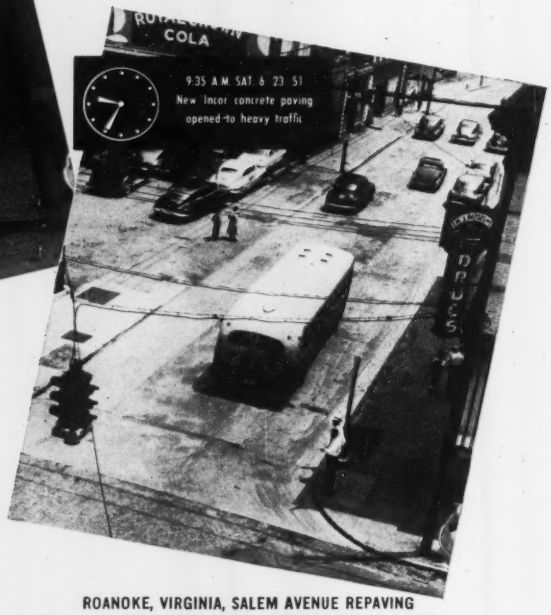
Hyster towing winches are used in these basic work classifications: CONSTRUCTION, INDUSTRIAL, LOGGING, MINING, OIL and GAS, MILITARY, AGRICULTURE, TRANSPORTATION, GOVERNMENT.

Any Caterpillar dealer will gladly tell you about Hyster tractor winches.

THE PUBLIC BE *PLEASED!*



Roanoke, Like Many Other Well-run Cities, Repaves with 'Incor' — Saving Motorists' Time and Tempers



● Closing a busy street like Salem Avenue in Roanoke, Virginia, for repaving can be a prolonged headache for motorists, a serious trade loss for merchants. But not if the city follows a policy of the public be PLEASED:

Like John L. Wentworth, Roanoke's Director of Public Works, who used 'Incor' 24-Hour Cement for repaving busy Salem Avenue from Jefferson Street, W., to Second Street, S. W.

Placed one day, 'Incor' concrete carried heavy mixer trucks the next. Result, Mr. Wentworth estimates a saving of 45 days' traffic tie-up.

Salem Avenue is typical of many a busy main stem the country over. With 'Incor,' motorists praise the foresight of progressive city fathers . . . merchants save sales that would otherwise be lost.

Good news for taxpayers, too . . . because dependable 'Incor'* high EARLY strength saves at the go in . . . dependable high ULTIMATE strength saves tax outgo, through extra years of maintenance-free service.

Serving public convenience today and the public pocketbook tomorrow . . . backed by nearly 25 years' dependable performance . . . deservedly, America's FIRST high early strength Portland cement.

*Reg. U.S. Pat. Off.

ROANOKE, VIRGINIA, SALEM AVENUE REPAVING
Engineers: **CITY OF ROANOKE ENGINEERING DEPARTMENT**
JOHN L. WENTWORTH, Director of Public Works
H. C. BROYLES, City Engineer
Contractor: **PIONEER CONSTRUCTION CO., INC.**, Roanoke
Ready-Mix 'Incor' Concrete: **CONCRETE READY MIXED CORPORATION**, Roanoke

LONE STAR CEMENTS COVER THE ENTIRE CONSTRUCTION FIELD

LONE STAR CEMENT CORPORATION

Offices: ABILENE, TEX. • ALBANY, N.Y. • BETHLEHEM, PA. • BIRMINGHAM • BOSTON • CHICAGO • DALLAS • HOUSTON • INDIANAPOLIS
KANSAS CITY, MO. • NEW ORLEANS • NEW YORK • NORFOLK • PHILADELPHIA • RICHMOND • ST. LOUIS • WASHINGTON, D.C.

LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 17 MODERN MILLS, 125,000,000 SACKS ANNUAL CAPACITY

VOLUME 21

NUMBER 9

CIVIL ENGINEERING

SEPTEMBER, 1951

THE MAGAZINE OF ENGINEERED CONSTRUCTION

WALTER E. JESSUP . . . . . *Editor*
C. E. BEAM . . . . . *Publication Manager*
ROBERT K. LOCKWOOD . . *Associate Editor*

Assistant Editors

Ruth G. Campbell . . . . . *Articles*
Mary E. Jessup . . . . . *News*
Doris A. Braillard . . . . . *Production*

JAMES T. NORTON . . . *Advertising Manager*

EDITORIAL & ADVERTISING DEPARTMENTS
33 W. 39th St. New York 18, N.Y.

ADVERTISING REPRESENTATIVES

- DWIGHT H. EARLY
  100 North La Salle St., Chicago, Ill.
- McDONALD-THOMPSON
  564 Market St., San Francisco, Calif.
  3727 West Sixth St., Los Angeles, Calif.
  750 Fulton St., Fresno 1, Calif.
  Terminal Sales Bldg.
  1st & Virginia Sts., Seattle, Wash.
  1118 Odeans Drive, Dallas 11, Tex.
  115 Southwest 4th Ave., Portland 4, Ore.
  317 Railway Exchange Bldg., Denver, Colo.
- L. H. DOLARO
  Transatlantic Publicity Ltd.
  20–21 Broad St. Ave., Blomfield St.
  London, E.C. 2, England

SOCIETY OFFICERS

GAIL A. HATHAWAY . . . . . *President*
WILLIAM N. CAREY . . . *Executive Secretary*
E. LAWRENCE CHANDLER *Assistant Secretary*
JOSEPH H. EHLERS . . *Field Representative*
1026 17th St., N.W., Washington 6, D.C.

The Society is not responsible for any statements made or opinions expressed in its publications.

SUBSCRIPTION RATES—Price 50 cents a copy, $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

PRINTING—Reprints from this publication may be made on condition that full credit be given to the author, copyright credit to CIVIL ENGINEERING, and that date of original publication be stated.

COPYRIGHT, 1951, BY THE AMERICAN SOCIETY OF CIVIL ENGINEERS
PRINTED IN U.S.A.

Member Audit Bureau of Circulations

IN THIS ISSUE

Revolutionary staircase built of prestressed concrete . *G. Magnel* 25

Beach protection engineers attempt to outwit nature at Presque Isle Peninsula . . . . . *Frank H. Forney and Gerald A. Lynde* 28

Steel-pan forms provide economical long-span roof . . *R. L. Reid* 32

Model study aids designers of spillway for Lyman Run Dam . . *Andre L. Jorissen and Vernon L. Dutton* 34

Heavy industrial development dictates tough construction site for Monongahela Locks No. 2 . . . . . *Wilfred Bauknight* 36

Ceylon's irrigation works, ancient and modern

Ceylon restores its ancient irrigation works . . *Paul von der Lippe* 41

Ceylonese learn American methods quickly on Gal Oya Dam . . . . . *D. J. Bleifuss* 45

Soundings above Niagara Falls obtained by helicopter and Kytoons . . . . . *Frank P. Bane* 49

Hydrodynamic pressure due to horizontal earthquake shock computed by curves . . . . . *Ven Te Chow* 52

Program of ASCE Annual Convention, New York 55

SOCIETY NEWS

Division Programs Planned at Chicago Conference . . . 63
ASCE Co-Sponsors First U.S. Conference on Prestressed Concrete . . . 64
ASCE Director Walter Ryan Dies in Office . . . 65
From the Nation's Capital . . . 66
News of Local Sections Briefed . . . 67

NEWS BRIEFS

Construction Activity in July Shows Small Increase . . . 68
Delaware Memorial Bridge Is Opened to Traffic . . . 69
Heavy Equipment Speeds Clean-Up in Midwestern Flood Area . . . 70
Large Titanium Plant Will Be Built in Nevada . . . 70
Monorail Transit System Planned for Los Angeles . . . 71
Water Conservation Program Combats San Diego Drought . . . 72
Prestressed Concrete for Industrial Buildings Studied . . . 73

DEPARTMENTS

Engineers' Notebook . . . 52
The Readers Write . . . 52
N. G. Neare's Column . . . 74
New in Education . . . 76
Deceased . . . 78
Meetings and Conferences . . . 85
News of Engineers . . . 84
Men and Jobs Available . . . 88
Recent Books . . . 94
New Publications . . . 96
Applications for Admission . . . 99
Equipment, Materials, Methods . . . 100
Literature Available . . . 104
Index to Advertisers . . . 112

Proceedings Papers Available as Separates 107

Barbara Fritchie's house in Frederick, Maryland as it appeared in the year 1866

The City of Frederick has a cast iron water main in service that was laid in 1845, seventeen years before Barbara Fritchie's flag-waving defiance of "Stonewall" Jackson's army. The changing channel of a creek undermined her humble home, now replaced in replica to serve as a museum. Yet Frederick's 106-year-old cast iron main, like many others, has survived the changing conditions of a century. Shock-strength, beam-strength and crushing-strength are inherent in cast iron pipe. Because of these strength-factors and effective resistance to corrosion, cast iron water and gas mains, laid over 100 years ago, are still serving in the streets of 38 cities in the United States and Canada. **United States Pipe and Foundry Co., General Offices, Burlington, N. J. Plants and Sales Offices Throughout the U. S. A.**

U.S. CAST IRON PIPE

NUMBER NINE OF A SERIES

PROF. G. MAGNEL, M. ASCE

University of Ghent, Belgium

Helicoidal staircase in prestressed concrete, built for General Motors Continental, Antwerp, Belgium, rises 17 ft unsupported, except at bottom and top—a daring structure in a beautiful setting.

Revolutionary staircase built of prestressed concrete

IN ANTWERP, General Motors Continental is building an important group of buildings which includes an assembly plant, show room, offices and storage space. From the luxurious show room a helicoidal staircase rises to join the offices on the floor above.

It is a daring structure which could not be built of the usual reinforced concrete. Even with the new technique of prestressing, the problem of design was so unusual that I could not take the responsibility for it without first making a full-scale model in my laboratory at Ghent and testing it under loads up to three and a half times the working load.

Design Based on Test of Full-Scale Model

The resisting element of the staircase is a helicoidal slab about 11 in. thick, supported only on the ground floor and at the office floor 17 ft 2 in. above. In the design of such a slab, the main problem is to take care of the very high torsional moments. Moreover, because no reliable formula exists for computing torsional stresses in very thin rectangular concrete sections, it was imperative first to test a full-scale model.

Dimensions of the tested model are shown in Fig. 1. The design method used is not exact—exact methods do not exist in engineering—but it is based on the results of the test. Test results are more reliable than theory.

Measured vertically, the thickness of the prestressed test slab is 13.4 in., but measured normal to its surface, it is 10.2 in. at the inside edge and 12.6 in. at the outside edge, an average thickness of 11.4 in. Design loads were taken at 176 lb per sq ft for dead load, 104 lb per sq ft for live load measured on a horizontal projection, a total of 280 lb per sq ft.

Design Procedure Explained

A routine calculation gives the following maximum values:

Bending moment for section A_1B_1 = 141,000 ft-lb

Torsional moment for section A_0B_0 and A_nB_n = 211,000 ft-lb

Shearing force for section A_0B_0 and A_nB_n = 29,100 lb

If the vertical reactions along one of the lines of support A_0B_0 or A_nB_n are assumed to follow a linear law (Fig. 2) we find, by applying the principals of elementary statics, that

S_A = 28,100 lb per ft, and
S_B = 37,000 lb per ft

Hence we can calculate the shear stresses due to the combination of the torsional moment and the shearing force as follows:

$$\frac{3 \times 37{,}500}{2 \times 11.4 \times 12} = 411 \text{ psi}$$

Prestressing was by means of two cables each containing 16 wires of 5-mm diameter, stressed at one end up to 145,000 psi. This gives a total force of 141,000 lb. However, the loss due to friction of cables against the concrete has been measured as being 45 percent. This leaves initially a prestressing force in section

ABSENCE of reliable design formulas required construction of full-scale model and test of its behavior under load. Steel frame and timber bracing provided support for top end of slab.

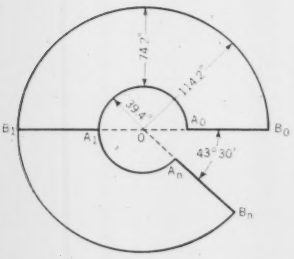


FIG. 1. DIMENSIONS of tested model are shown by diagram. Vertical distance between A_0B_0 and A_1B_1 equals 17 ft 2 in.

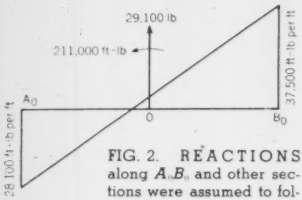


FIG. 2. REACTIONS along A_0B_0 and other sections were assumed to follow linear law.

MODEL is loaded to $3\frac{1}{2}$ times working load of 104 lb per sq ft. Timber struts under right side are for safety and do not touch slab. Deflection under twice working load (Fig. 3) was about $\frac{3}{4}$ in.

A_1B_1 equal to 77,600 lb; and ultimately because of a 15-percent loss of prestress in the course of time, the following prestressing forces:

In A_0B_0, $0.85 \times 141{,}000 = 134{,}000$ lb
In A_1B_1, $0.85 \times 77{,}600 = 66{,}000$ lb

This prestressing gives a compressive stress in the concrete at A_0B_0 equal to 157 psi.

With a shearing stress of 411 psi and a compressive stress of 157 psi, the maximum principal tensile stress equals

$$\sqrt{411^2 + \frac{157^2}{4}} - \frac{157}{4} = 340 \text{ psi}$$

Now compute the stresses in A_1B_1 due to the bending moment of 141,000 ft-lb and the axial compression of 66,000 ft-lb. The cross section is 11.4×74.8 in., reinforced with 1.04 sq in. of steel per ft on the tension side and 0.52 sq in. per ft on the compressive side. This gives a concrete stress of 1,150 psi and a steel stress of 16,600 psi.

Let us see next what these figures became during the test when the first crack appeared, which was under a live load of 245 lb per sq ft. This load added to the dead load totaled 421 lb per sq ft, or 1.51 times the working load previously computed.

Hence the maximum shearing stress was

$$411 \times 1.51 = 620 \text{ psi}$$

With the same prestressing as above, the maximum principal tensile stress was

$$\sqrt{620^2 + \frac{157^2}{2}} - \frac{157}{2} = 547 \text{ psi}$$

In section A_1B_1 there was a bending moment of

$$1.51 \times 141{,}000 = 213{,}000 \text{ ft-lb}$$

which, with the same prestressing force as before, produced a stress in the concrete of 1,720 psi, and in the steel of 25,500 psi. It is obvious that the concrete did not have a tensile resistance as high as 547 psi although its crushing strength in 8-in. cubes was 9,000 psi. This showed that the computation was not quite correct. If the tensile strength of the concrete is assumed to be 350 psi the calculated figure for the principal tensile stress is 1.56 times too high.

If the principal tensile stress due to the combination of the torsional moment and the shearing force had been computed by applying known formulas for rectangular cross sections, values would have been found three times higher than those given by the test. For this reason, I place more confidence in the method used and here described.

Test Results Converted to Design

Stresses in the real staircase, as it was built in Antwerp, can now be computed. It differed from the model in that its width was 86.8 in. whereas the model had a width of 74.8 in. The slab thickness remained the same, as did the percentage of reinforcement. The prestressing was applied by six cables instead of two. This increased the applied prestressing force to $3 \times 141{,}000 = 423{,}000$ lb. The prestressing was applied by jacking both ends of the wires in order to reduce the friction loss from 45 to 22.5 percent. These conditions give the following ultimate prestressing forces:

In section A_0B_0, $0.85 \times 423{,}000 = 360{,}000$ lb

In section A_1B_1, $0.85 \times 0.775 \times 360{,}000 = 237{,}000$ lb

The loads to be considered are the same as those previously used for the model, but because of the increased width, they give the following values:

Bending moment = 164,000 ft-lb

Torsional moment = 245,000 ft-lb

Maximum shear (Fig. 2) = 32,900 lb per ft

Hence the value for the maximum shear stress becomes

$$\frac{3 \times 32{,}900}{2 \times 11.4 \times 12} = 360 \text{ psi}$$

The compression in A_0B_0 due to the prestress is equal to 364 psi. Hence

the maximum principal tensile stress is

$$\sqrt{360^2 + \frac{364^2}{4}} - \frac{364}{2} = 222 \text{ psi}$$

Next the stresses in the section A_1B_1 are computed under the bending moment of 164,000 ft-lb and the axial compression of 237,000 lb and are found to be

In the concrete, 1,120 psi

In the steel, 9,500 psi

Again the calculated principal tensile stress is too high. Assuming the same error as for the model, this stress under working conditions would really be

$$222 \div 1.56 = 142 \text{ psi}$$

which is a low stress for concrete having a crushing resistance of 9,000 psi.

Deflections measured during the test of the model are shown in Fig. 3. They are quite reasonable under working load conditions. The deflections of the actual stairway will be less, first, because it is stronger than the model; and secondly, because the top support of the model was not rigidly fixed in space. The steel columns and their timber struts, which supported the top of the model, took some elastic deformation during the test.

During the laboratory test great care was taken to measure the loss of prestress due to the friction of the cables against the helicoidal channels cast through the slab. In the model prestressing of the two cables was from one end only; in the actual staircase prestress was applied simultaneously to each pair of wires at each end of the slab.

This staircase is exceptional not only because of its striking shape and the application of prestressed concrete to its construction, but also because of the artistic and elegant manner in which the architects finished it. The stair treads fixed on the slab are of stainless steel, and the handrails are of bronze supported by aerodynamically shaped verticals of stainless steel.

Credit for this unique engineering structure is given to the owners; to their architects, Messrs. Cole and De Roeck of Antwerp; to the consultant architects, Messrs. Smith, Hinchman and Grylls of Detroit and New York; to the general contractor, S. A. Blaton-Aubert of Brussels; and to all those who did their utmost to finish as perfectly as possible this engineering and architectural jewel.

PRESTRESS WAS APPLIED to actual staircase by six cables, each cable containing 16 wires of 5-mm diameter. Wires were post-tensioned by jacking them in pairs from both ends to a stress of 145,000 psi.

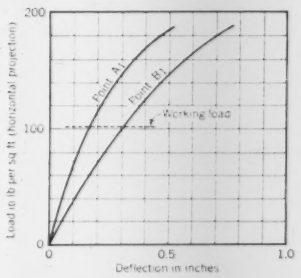


FIG. 3. DEFLECTIONS on loaded model were measured at A_1 and B_1 (Fig. 1).

STAINLESS STEEL TREADS, bronze handrails supported by stainless steel balusters, and precision workmanship contribute to perfection of unique engineering structure.

Beach protection engineers at Presque Isle Peninsula

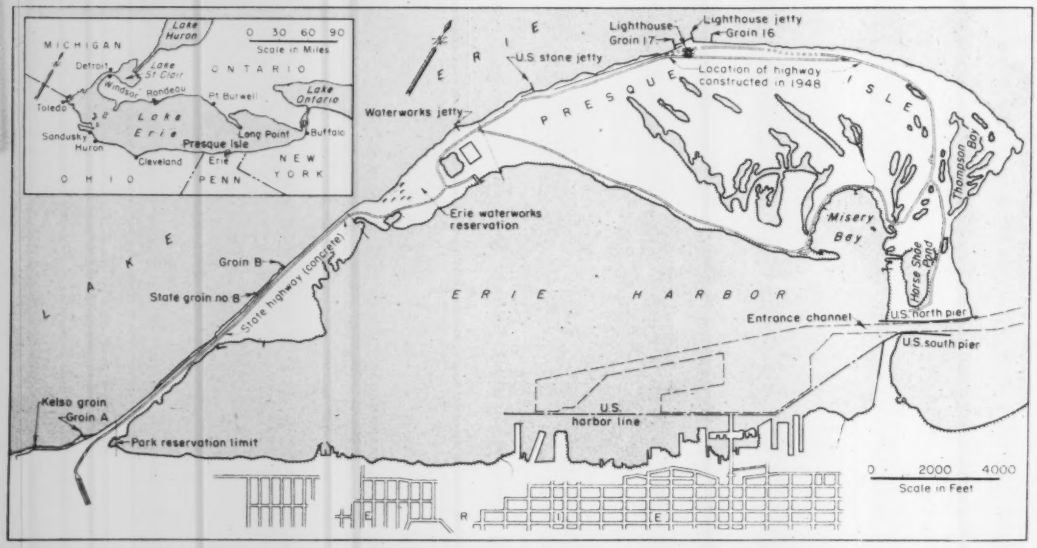
VIEWS looking east along neck of Presque Isle Peninsula from Kelso Groin (Fig. 1) show condition before (above) and after (below) stone-faced bulkhead construction in 1943-1944.

BEACH EROSION has become a very serious problem on the Great Lakes because of the high value and extensive improvement of shore properties. Presque Isle, Fig. 1, a unique peninsula on Lake Erie, at Erie, Pa., is a compound recurved sandspit projecting about 2½ miles from an otherwise straight mainland shore. From its root to its distal end it has a lake shore line about six miles long. The large landlocked bay between the peninsula and the mainland provides a spacious harbor which has been improved by the Federal Government as a deep-draft navigation project.

This was the first harbor project ever undertaken by the Federal Government under the Corps of Engineers, the original act authorizing improvement having been passed on March 3, 1823. The earliest survey was that made by Maj. John Anderson of the Corps of Topographical Engineers, in 1819. Nine other surveys have been made, the latest in 1947. The chart, Fig. 2, shows the shore lines of 1819, 1866 and 1947, from which it can be seen that the peninsula has migrated toward the east. Measurement of the areas within the shore lines with a planimeter shows that there has been a net increase in area between 1819 and 1947 of approximately 68 acres. Since 1819 the project has been active, and almost continuous attempts have been under way to solve the problem of beach erosion, at least to the extent of preserving the harbor.

The peninsula fully justifies its name of "nearly an island" by shrinking to a width of about 250 ft at its shore connection. From this narrow

FIG. 1. STABILIZATION of Presque Isle Peninsula, which forms Erie (Pa.) Harbor, was first harbor project ever undertaken by Corps of Engineers. Erosion of this peninsula has been problem since 1823, and its narrow neck has been breached three times by storms from west. After failure of control works built by U.S. Government and State of Pennsylvania, these agencies have combined to develop plan for comprehensive system of groins, bulkheads, and artificial beaches.



attempt to outwit nature

FRANK H. FORNEY, M. ASCE, Colonel, Corps of Engineers, Dept. of the Army
GERALD A. LYNDE, Civil Engineer, Office of District Engineer, Buffalo, N.Y.

THE SENIOR author, Colonel Forney, was killed in action in Korea on November 29, 1950. When hostilities started last June, 1950, he was District Engineer at Buffalo. Because of this experience and his World War II service as an Engineer Group Commander, he was transferred in that July to Fort Campbell, Ky., to head such a group. He took part in the amphibious landings at Inchon, and participated with his unit in building several vital bridges during the Han River offensive.

This article is based on a paper prepared by the authors and delivered by Colonel Forney before the Waterways Division at the joint EIC-ASCE Summer Convention in Toronto. In it the authors discuss the forces which cause beach erosion, the effect of these forces, and the design of various types of remedial structures, as illustrated by the phenomena encountered on Presque Isle Peninsula, which forms Erie Harbor, at Erie, Pa. The beach erosion problems on a large lake, such as Lake Erie, are in many respects the same as on an ocean shore, and therefore the methods used at Presque Isle, if successful, will be widely applicable.

neck it varies to a maximum width of about 1¼ miles toward the distal end. The lakeward shore of the spit is, in general, a flat sandy beach except where the neck has been protected by sea walls. Its regularity and continuity are broken only at points where protective works have altered the natural contour of the shore line. Presque Isle State Park, comprising about 3,200 acres, occupies practically the entire peninsula. An access road from the mainland enters along the neck of the peninsula and continues around its perimeter.

Neck of Peninsula Breached Three Times

Predominant littoral drift in this area is from west to east. During the period of record the supply of beach material from bluffs and streams west of the peninsula has been insufficient to replace the material eroded from the neck of the spit. Recession of the shore line has been greatest at the root of the peninsula, gradually decreasing to a nodal point about two-thirds of the length of the peninsula from the root, beyond which point accretion has occurred as the eroded material has been deposited.

The neck of the peninsula has always been considered extremely important to Erie Harbor since it forms a west breakwater, without the protection of which the harbor would be unusable. The neck has, however, been breached three times by heavy storms.

The first breach occurred in 1833 and remained until 1864, when it was closed by nature. Between 1836 and 1844, work was almost continually in progress in an unsuccessful attempt to close the breach. Finally it was decided to leave a westerly entrance to the harbor, and during 1836 and 1837, 2,340 ft of crib-work breakwater, equal to one-third the length of the breach, was built. Additional cribbing was built in 1838, 1839 and 1844. By 1852, practically all this cribbing had been destroyed. In 1853, 1854 and 1855, work was carried on to close the breach with a brush and stone revetment but it was not completed. All work was stopped from 1855 to 1864 because no appropriations were made. In 1864 the breach was closed by nature and the project for a western entrance to the harbor was abandoned.

In 1872, more brush and stone were placed to strengthen the neck, but it was again breached during a heavy storm in November 1874. Bulkheads constructed during 1875, 1876 and 1877, to a total length of 6,547 ft, resulted in the closing of the breach in the latter year.

In 1881, nine pile jetties were constructed at right angles to the shore to prevent erosion. Eight of them, spaced at 200-ft intervals, were constructed at the neck, and the ninth was two miles further along the peninsula. In 1882, 2,000 ft of revetment were renewed, and in 1883 the bulkhead fences were repaired.

Principles of Beach Erosion Control Summarized

Basic problems of absorbing wave energy and controlling movement of beach material are fundamentally the same on large lakes as on ocean shores.

Total energy of a wave is very great. Force of moving water when converted to kinetic energy, as when a wave breaks, is capable of inflicting great damage.

Common method of measuring littoral drift is to compute yardage of material impounded by an existing structure.

On Great Lakes, erosion is rapid during high water level, and is retarded when water level is low.

Shore erosion can be controlled by one, or a combination of more than one, of the following methods—riprap, bulkheads, groins, artificial replenishment of beach, and provision of a "feeder beach."

Cellular sheetpile bulkheads are considered more reliable and no more costly than well anchored cantilevered steel sheetpile bulkheads. Cellular bulkheads are usually built to high-water level plus wave height, and landward side is paved.

Vegetation alone is totally ineffective against vigorous or continuous wave action, but planting of trees and shrubs reduces wind erosion of sand beaches and dunes.

Erosion of lake bottom at toe of vertical bulkhead may extend to depth below still water equal to height of waves acting on bulkhead.

Broad, gently sloping beach is most effective means of absorbing wave energy. If there is sufficient littoral drift, a system of groins will create such a beach. Shore end of groins should be built up above high-water level to height of anticipated waves, and groins should, where practicable, extend out to point where water is at least 6 ft deep if intended to trap littoral drift, or to the toe of the fill if a beach is built artificially.

Suitable beaches can be built up artificially by dumping or pumping hydraulic fill.

Where littoral currents carry inadequate supply of material, a "feeder beach" built up of dredged material will supply the downdrift areas.

STATE GROIN No. 8 (far left), of sheetpiles 20 ft long, extends 220 ft lakeward from stone-faced bulkhead. Built in 1931, outer 100 ft was subsequently destroyed by storms.

EXPERIMENTAL Groin B (left), of rubble-mound construction, built in 1943, extends 300 ft into Lake Erie. Its condition is still good.

In 1885, a timber crib and rubble-mound "sand catch," known as the Lighthouse Jetty, or U. S. Jetty No. 1 (Fig. 1), was constructed. In 1887, it was reported that for a distance of 5,000 ft west of the jetty, accretion up to 100 ft in width had taken place. This is the oldest protective work on the peninsula that is still in place.

In 1887, the Engineer Officer-in-Charge reported that the protection fences and pile jetties at the neck were in ruins, so that the effect was as though they did not exist. The last of these fences and pile jetties was carried away in 1893.

Planting of trees to prevent erosion was started in 1873 and carried on from time to time on a small scale. Despite the failure of these early efforts, a very vigorous planting campaign was inaugurated in 1896 and carried on intermittently until 1922. These plantings failed completely to prevent erosion along the shore during severe storms but have reduced the direct movement of sand by wind.

In 1900, the first of four experimental jetties was built. These jetties were to be built one at a time so that their effect might be studied. The first one, known as Stone Jetty, was a stone-filled timber crib 290 ft long, 12 ft wide by 11½ ft deep, and had a "T" at its outer end 32 ft in length. The second of these jetties, known as the Water Works Jetty, was built in 1903. In 1907 it was reported that both these jetties had failed to prevent erosion, and the construction of the other two was abandoned. The two structures are still in place with extensive beaches on their updrift sides, and it now appears evident that if they had been augmented by a comprehensive system of groins and bulkheads, erosion of the outer part of the peninsula might have been checked at that time.

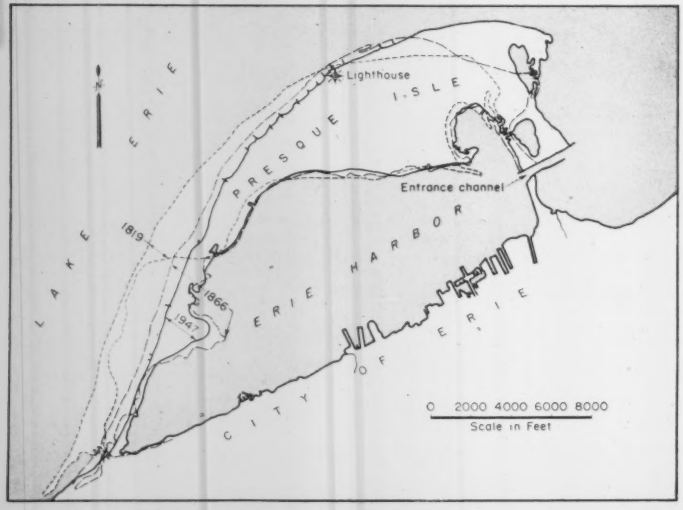
In October 1917, the neck was again breached. An unsuccessful attempt was made in 1918 to close this breach by means of a pile and sheetpile bulkhead. Closure was again started in 1920 by construction of a rubble-mound wall 1,700 ft long, in a trench excavated to near bed rock with a sand fill behind it. This work was completed in 1922. To add further protection, the rubble-mound wall was extended eastward along the shore by riprap a total distance of 2,625 ft. All this construction is still in place, although it has been badly damaged in places from time to time.

In 1930 and 1931, 5,281 lin ft of steel sheetpile bulkhead were constructed, of which 5,050 ft were faced with stone. Some of the stone facing has had to be reconstructed. East of Groin B, erosion is taking place at the toe of the stone facing, and it is evident that the quantity of stone will have to be greatly increased if the wall is to be maintained by that means.

All the bulkheads so far described were constructed by the Federal Government, and were located at the neck of the peninsula. In addition, the State of Pennsylvania has built approximately 2,600 ft of bulkhead along the neck of the peninsula and other bulkheads and numerous groins located further out on the peninsula in order to retain a beach and prevent the destruction of the highway. The history of the groins and bulkheads constructed by the state is no brighter than that of those built by the Federal Government. All the state groins have been built since 1927, and most of them are single-row sheetpiling.

Between the Water Works Jetty and a point west of the Lighthouse Jetty, the works have been fairly effective and have succeeded in maintaining a reasonably stable beach. Between this point and the Lighthouse Jetty, the storm of 1942 attacked the beach and destroyed a part of the highway. Eastward of the Lighthouse Jetty the highway for a distance of almost a mile has been progressively destroyed and 200 to 300 ft of land carried away. Works in this area, consisting of bulkheads, cantilever sheetpile groins and two permeable groins built up of precast concrete blocks, have not only failed to protect the shore but have themselves failed structurally.

FIG. 2. STORMS and littoral drift from west caused neck of Presque Isle Peninsula to migrate half mile eastward between 1819 and 1947. During same period, accretion at easterly tip of peninsula caused it to "grow" ¾ mile toward east.



State and Government Prepare Joint Plan

A cooperative beach erosion control study for Presque Isle was undertaken in 1939 by the Commonwealth of Pennsylvania and the Corps of Engineers, which forms the basis of the present proposed action. This study followed the general pattern of making topographic surveys, taking offshore profiles and measuring the quantity of material in movement.

To determine the rate of sand supply by littoral movement, either to the peninsula or along its lake-

ward face, two 300-ft stone groins (Groin A + Groin B) were built. These groins and 2,750 lin ft of sea wall eastward of Kelso Groin were completed in 1944

A preconstruction survey was made in July-August 1943 to furnish basic data from which to observe the effects of the new work. Aerial vertical photographs were obtained and ground photographs of existing structures and beaches were made to serve as a permanent record of preconstruction conditions. The first post-construction survey was made in 1944. Since then surveys have been made annually at approximately the same time of year to avoid the effects of seasonal changes. By 1947, it was concluded that sufficient data were available to make a satisfactory analysis of the problem. Again profiles were obtained, a plane-table survey of the beach area was made, and aerial photographs of the lakeward perimeter of the peninsula were taken.

Littoral Currents Supply Insufficient Material

From the data furnished by the periodic surveys, it was estimated that approximately 18,000 cu yd annually are supplied to the root of the peninsula, which includes all the material moving inside the 18-ft-depth contour. Between the two experimental groins (A and B, Fig. 1), an annual loss of approximately 19,000 cu yd of sand occurred, while in the 31,000 ft east of Groin B, the annual sand loss was approximately 285,000 cu yd. It was established that the rate of supply of material was inadequate to maintain existing beaches along the neck of the peninsula, or to rebuild beaches with the aid of groins designed to trap the natural supply. Wave refraction diagrams confirmed the available information that easterly storms have caused less damage than those from the west.

The proposed protection has at least three distinct purposes: (1) preservation of the neck of the peninsula to protect navigation improvements in Erie Harbor, (2) stabilization of the existing shore line and uninterrupted use of the access road along the neck of the peninsula, (3) restoration of bathing beaches.

To preserve the neck of the peninsula as a breakwater for Erie Harbor, construction of a heavy bulkhead would suffice. In fact bulkheads have already been built along most of its length, but have been only partially successful, and their maintenance has been costly. Also such breakwaters cannot accomplish the second and third objectives mentioned above. For these reasons the plan considered most satisfactory for protection of the neck is the restoration of sand beaches by artificial fill and construction of groins to materially reduce the rate of littoral movement and the loss of sand.

All three objectives can be accomplished by the construction and maintenance of a beach. A wide beach will absorb the energy of storm waves and prevent overtopping of existing sea walls and bulkheads and consequent inundation of the highway. It is planned to place a beach about 300 ft wide along the neck, to a point about midway between Groin B and the Water Works Jetty, a project that will require about 1,500,000 cu yd of sand. The sand can either be pumped from the east end of the peninsula or brought into the bay by "sand-suckers" and pumped over the neck. It is also proposed to construct groins to retard the littoral movement of this sand.

"Artificial nourishment" from feeder beaches is also required for the protection and improvement of the peninsula east of this point. The use of bulkheads in this part of the lakeward face is not considered as essential as along the neck, where they serve as the last line of defense for protection of the highway and harbor in case of temporary loss of a part of the beach. East of the neck, the highway and other permanent installations are far enough away from the shore line to be out of immediate danger. It is therefore proposed to place a stockpile or feeder beach of sand at the easterly end of the neck, near the water works, to serve as a source of supply on which littoral currents can draw to distribute sand along the beaches to the east. Approximately 1,000,000 cu yd is considered adequate for the initial fill.

There is no way of predicting what the rate of loss from this feeder beach will be. It is therefore proposed to make periodic surveys following placement of the sand to determine whether the construction of groins would reduce the rate of littoral movement and thus reduce the annual costs. If the required average annual replacement of sand to the feeder beach can be sufficiently reduced to more than offset the amortization costs for the groins, their construction would be justified.

Adoption of a project, the cost of which would be shared by the Federal Government and the Commonwealth of Pennsylvania, has been recommended by the Chief of Engineers in his report on the cooperative beach erosion control study. The report has not yet been presented to Congress for authorization of the proposed project. During the critical period which has existed since the study was completed, consideration of civil works projects not directly connected with the defense effort has been delayed and subordinated to more urgent matters.

The proposed improvement of Presque Isle Peninsula is particularly interesting because it involves the combined use of practically all the conventional methods of erosion control. It illustrates the utter futility of trying to cope with such problems by halfway measures and inadequate structures. Such structures are usually the result of imperfect understanding of the problem, and thus further illustrate the value of detailed survey data. With such data, a problem can be solved with reasonable hope of success; without them, the design becomes largely a matter of guesswork and rule-of-thumb.

STATE GROIN No. 17, built in 1947 of steel sheetpiles 20 to 35 ft long, extends out 300 ft and is still in good condition.

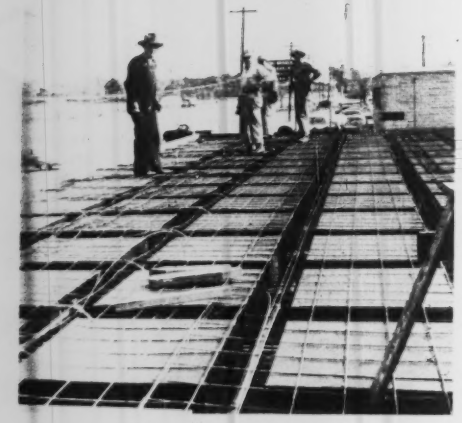
MIDDLE THIRD of State Groin No. 16 (Fig. 1), built in 1947 of steel sheetpiles 20 to 36 ft long, failed in same year it was constructed. Beginning of failure is shown.

STATE BULKHEAD 800 ft east of lighthouse (Fig. 1), constructed in 1932 of steel sheetpiling 20 to 22 ft long, failed in numerous places during 1943.

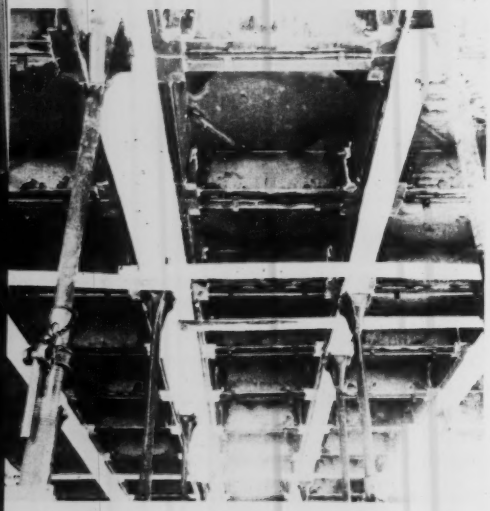
Steel-pan forms provide long-span

R. L. REID, Assoc. M. ASCE,

FINISHED CEILING before application of two spray coats of paint clearly reveals structural framing. Formed surfaces required no rubbing. In this grocery store area, unobstructed span is 40 x 74 ft.



TOP VIEW of steel-pan forms in place shows reinforced steel for roof joists and slab. Reinforced concrete joists 8 in. deep are 6 in. wide on bottom, and are covered by 2½-in. slab. Roof joists were generally reinforced with two 1⅛-in. square bars the short way, with one bent up, and two 1-in. round bars the long way, with one bent up. Extra bars, usually 1-in. rounds, were needed over the interior beams to take care of negative moments.



UNDER SIDE of steel-pan forms in place shows method of support. Pans are so designed that sides can be flexed for easy removal. Pans 3 ft square were manufactured from sheets 52 in. square by cutting out corners and bending down sides 8 in.

USE of specially designed steel-pan forms for the roof of a one-story brick building recently constructed in Spring Branch, Tex., permitted the elimination of interior columns in the various areas, the largest of which, for the grocery store, is 40 x 74 ft. The unusual method of framing the reinforced concrete roof proved practical and economical and contributed to speed of construction. This building, called the Spring Branch Community Center, and owned jointly by Jay Fuller and John Jones, houses the post office, the school board, a grocery store and a print shop (Fig. 1).

The roof covers a total area of approximately 6,000 sq ft, divided into three panels as shown in Fig. 1. Each area is bounded by a system of concrete columns and beams, thus making it structurally a modified two-way slab design.

Because of the immediate availability of metal sheets 52 in. square for the steel-pan forms, a modular unit of 3 ft was chosen. Bending down 8 in. on each side of the sheet to form the sides of the pan, left a center 3 ft square. The joists are 8 in. deep and 6 in. wide on the bottom. They are covered by a 2½-in. slab. The completed roof slab weighs 63 lb per sq ft and is designed for a live load of 30 lb per sq ft, in compliance with local building codes.

As shown in a photograph, the roof slab was left exposed on the under side to reveal the structural framing. The only treatment the slab received was two coats of white paint sprayed directly on the rough concrete. No rubbing of the concrete surfaces was considered necessary as the steel-pan forms left a true surface.

Several problems had to be solved to make this method of design workable. First came the problem of finding an economical method of forming the reinforced concrete joists.

economical roof

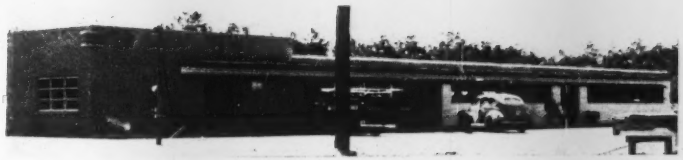
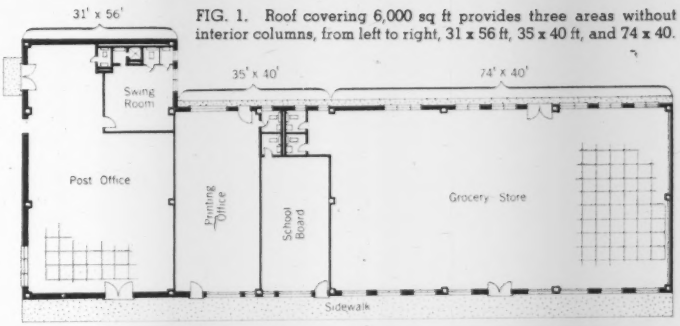
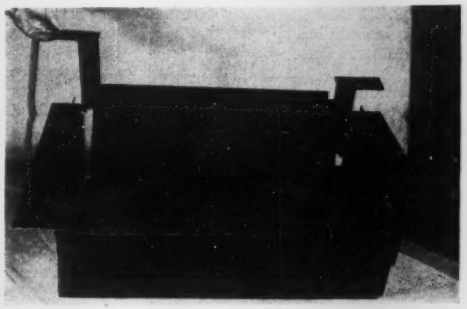


FIG. 1. Roof covering 6,000 sq ft provides three areas without interior columns, from left to right, 31 x 56 ft, 35 x 40 ft, and 74 x 40.





SQUARE STEEL-PAN FORM, of 16-gage metal sheet, has removable corner pieces, to make it collapsible for easy removal and reuse. Designer and maker of these forms, J. & B. Manufacturing Co. of Houston, Tex., erected and removed them on job, as subcontractor on form work.

Structural Engineer, Houston, Tex.

This problem was solved by the use of the steel pans described above. Wood forms were ruled out because they could not be reused often enough to make them practical. The use of sheet steel pans seemed to be the best answer, but no forms of this type were available.

The problem was explained to the J. & B. Manufacturing Co. of Houston, Tex. It was pointed out that if they made square pans they could reuse them on many different jobs, whereas rectangular pans for a one-way system would always result in a loss because expensive remaking would be necessary to fit different job conditions.

The company was to design and make the forms, erect them, and remove them. The contract price for this work was $3,200, or 5$3\frac{1}{3}$ cents per sq ft. This price was agreed on before the building was designed in detail, as all competition on this building would be eliminated once it was designed on the basis of using such steel-pan forms. Then, on this basis, the plans were started. It had been agreed that a construction joint would be provided in the roof in such a location that only half the total number of steel-pan forms would have to be provided, as the joint would allow them to be reused once. Thus only enough forms for 3,000 sq ft were manufactured.

Several factors were considered in the design of the pan-type forms. First, since the concrete ceiling was to be exposed, lap joints had to be eliminated and all forms held true with tight joints. Second, in designing an all-metal form, soffits included, the ease with which the forms could be removed without damage was highly important. To accomplish this, a collapsible pan was devised which would permit flexing the sides for removal. Third, the forms had to be built so that they could be quickly set on the skeleton framework, which consisted of 4 x 6 stringers and adjustable shores spanning in one direction only.

All work on the building except the forming was done by the successful bidder, the Harris Construction Co. of Houston, Tex., for a contract price of $47,000. This total can be broken down as follows:

Foundation and 4-in. concrete slab floor	$ 4,602
Concrete columns	1,333
Roof and canopies	14,885*
Total for concrete work	20,820
Masonry walls, plumbing, lighting, finish work and hardware	26,180
Total contract price	$47,000

This one-story brick building is supported on under-reamed footings and grade beams. The floor is a 4-in. concrete slab on sand fill. Because of the unusually long spans and to eliminate compression steel, a concrete compressive strength of 3,750 psi in 28 days was found necessary in the columns and roof beams and roof slab. To obtain this strength, the following quantities were used, per cubic yard: 5.15 sacks portland cement, 1,275 lb sand, 2,025 lb gravel, and 26 gal water.

In this building, the wide unsupported spans provide a maximum of flexibility as well as additional rental space. Also, considerable economy was realized by the omission of a plastered ceiling and the elimination of any rubbing of the concrete. The finished structure demonstrates the success of the design, and the over-all cost indicates its economy.

Architectural plans for the building were furnished by the architect, F. Perry Johnston. The structural design and specifications were furnished by the writer.

* Includes $3,200 paid to subcontractor, J. & B. Manufacturing Co., for form work.

Model study aids designers of spillway

ANDRE L. JORISSEN, Assoc. M. ASCE, and VERNON L. DUTTON, Respectively Professor and Instructor,

SINCE a curved channel cannot be designed by the classical theory of flow in open channels, model studies were needed for the spillway of the Lyman Run Dam. Foundation conditions required that the spillway be placed at one end of the dam, well into the hillside, with the result that the concrete spillway chute had to be curved to bring the water back into the river. A capacity of 25,000 cfs is required to handle expected floods.

Lyman Run Dam, an earth structure about 1,200 ft long and 50 ft high, is under construction in the Susquehannock State Park to create a 40-acre recreational area. It is being built for the General State Authority and the Department of Forests and Waters of the Commonwealth of Pennsylvania by Chester Engineers of Pittsburgh.

The normal discharge of Lyman Run will pass through the dam in a 5x5-ft concrete culvert, so that the spillway will be used only for flood flows. The bottom slope of the channel varies from 5 to 20 percent and is superelevated around the bend. The width tapers from 125 ft to 80 ft (Fig. 1).

Although much information is now available on the mechanics of supercritical flow and on the design of curved channels for such flow (see ASCE TRANSACTIONS for 1949, as a recent source), the operating characteristics of a given design are still best predicted by model study. The investigation of the Lyman Run spillway was made in the Hydraulics Laboratory of The Pennsylvania State College, Department of Civil Engineering, at the instigation of the Chester Engineers.

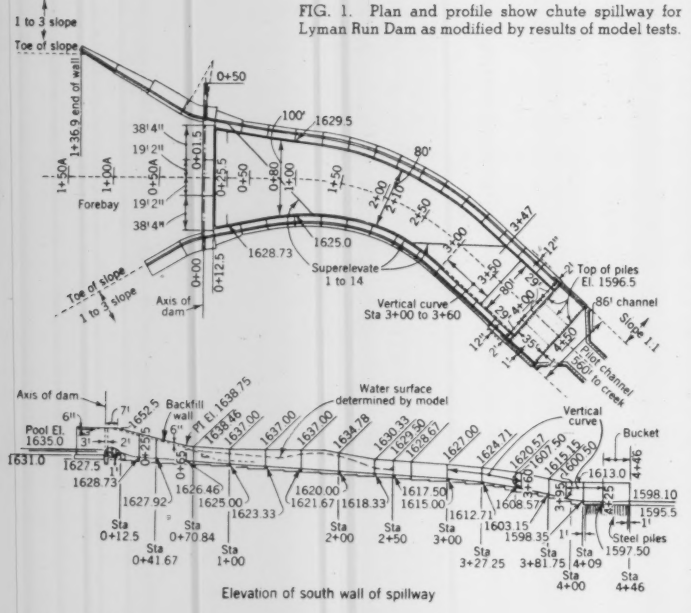
To study flow conditions in the channel, particularly at the bend and at the bottom of the chute, a model of the initial design was constructed to a scale of 1:48 (1 in. = 4 ft), chosen both because of the facilities available and because it was desirable to maintain a reasonable depth of water in the model channel. The model has three parts—approach section, weir and spillway channel, and downstream basin.

The approach section is fed by the laboratory pumps through a 6-in. cast-iron supply pipe discharging into the bottom of a tank 6 ft deep, which overflows smoothly into the model. A standard calibrated thin-plate orifice installed in the supply pipe measures the rate of flow. This approach section, built in timber made watertight by calking and painting, duplicates an area 400 ft long and 300 ft wide, just upstream of the spillway. South and north wing walls direct the water toward the spillway.

The weir and spillway channel were made of 20-gage galvanized steel sheets.

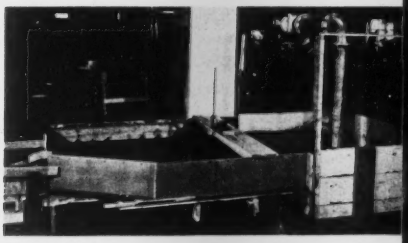
The downstream basin, that is, the water level in it, may affect flow conditions in the spillway channel. Therefore as large a part of the basin as space limitations permitted was constructed in the model and the studies were extended to include various water-surface elevations in this basin. Contour lines in the basin were drawn to scale on sheets of tar paper laid on the floor. Long strips of sheet metal of uniform width were then placed vertically and made to conform with the contours. These

FIG. 1. Plan and profile show chute spillway for Lyman Run Dam as modified by results of model tests.



for Lyman Run Dam

Department of Civil Engineering, The Pennsylvania State College, State College, Pa.



WATER from laboratory pumps is discharged through 6-in. cast-iron supply line at bottom of 6-ft-deep tank at right, whence it overflows smoothly into approach section of model, at left.

strips were of such height that their top edge corresponded accurately with the ground contour elevations. The space between the metal strips was filled with gravel, which was then covered by a thin layer of concrete. A shape was thus obtained which accurately duplicated the topography of the downstream basin.

Tests were made with discharge conditions representing the range from zero to 25,000 cfs, and with water-level elevations in the downstream basin corresponding to pool elevations between 1,600 and 1,625 ft.

Operation of the spillway channel, as originally designed, was found to be satisfactory only for flows up to 18,000 cfs. Because of the changes in direction of the walls, shock waves appeared at the entrance section. These waves, their interferences and reflections, are typical of high-velocity flow in curved channels. For rates of flow greater than 18,000 cfs, the amplitude of the waves was such that the channel overflowed. These conditions were the same for all water-surface elevations in the downstream pool.

At the upstream end of the channel, the height of the wing walls directing the water toward the spillway was found to be insufficient. Therefore these walls were raised to avoid overflow just upstream of the spillway weir.

Although no scouring measurements were made, observation of flow conditions in the downstream basin showed that high erosive action could be expected on the river bank opposite the discharge end of the spillway.

The original model showed that the spillway, as initially designed, was inadequate to carry flows greater than 18,000 cfs. An even lower capacity might be expected in the prototype owing to greater air entrainment and insufflation. The design was therefore revised to provide an improved entrance section, greater lateral superelevation of the channel bottom (1:14 instead of 1:28), and a longer apron at the lower end of the spillway. Furthermore, it was decided to choose the height of the walls from the model results.

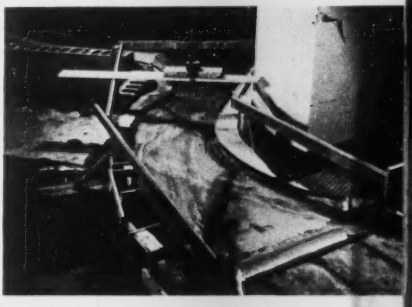
The model of the revised design showed greatly improved flow conditions. A shock wave, generated at the toe of the weir on the north wall, crossed the channel and was reflected by the south wall. This wave met another wave generated at the toe of the weir on the south wall. These conditions were qualitatively the same for all rates of flow. The amplitude of the waves was much smaller than in the original design.

Free-flow conditions in the upper part of the channel were unaffected by the presence of a hydraulic jump in the downstream basin. When the water surface in this basin reached an elevation of 1,615, the hydraulic jump was located at the lower end of the channel. For greater surface elevations, the hydraulic jump affected the flow in the lower part of the channel.

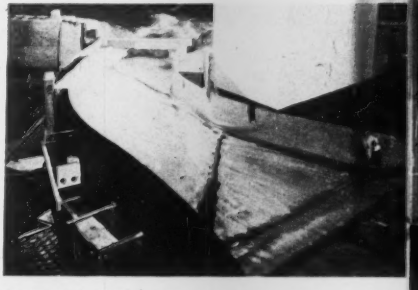
The revised design not only showed improved flow conditions but also appeared to have the necessary capacity.

The model study provided the following information for the designers:

1. Need for a steeper lateral slope on the superelevated portion of the bottom of the spillway.
2. Need for higher walls, and the region in which the increased height was required.
3. Need for a different type of approach to the spillway from that originally designed.
4. Wave conditions that would be encountered if a pool should form in the valley downstream from the dam.
5. Danger of large scouring forces under flood conditions, this factor being of importance in planning for the maintenance of the dam and spillway.

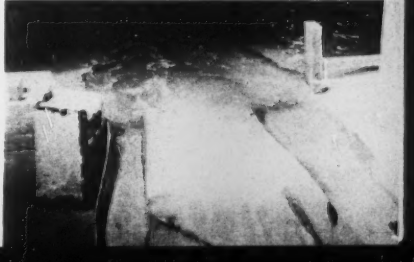


FIRST MODEL of spillway chute developed shock waves which overflowed walls at equivalent flow of 18,000 cfs.



REVISED MODEL, with steeper superelevation and higher outside wall, safely carries flow equivalent to 25,000 cfs.

HYDRAULIC JUMP is formed at lower end of spillway channel with downstream pool at highest elevation (1,625) and spillway carrying equivalent of 25,000 cfs.



WILFRED BAUKNIGHT

Chief, Construction Division,
Pittsburgh District, Corps of Engineers,
Pittsburgh, Pa.

Heavy industrial development dictates tough construction site for Monongahela

IN REBUILDING Locks No. 2 on the Monongahela River at Pittsburgh, Pa., Army Engineers were faced with bad foundations, unstable banks closely built up with vital industrial facilities, and heavy river traffic which must not be seriously hampered.

The construction work, which is being supervised by the Pittsburgh District, Corps of Engineers, U.S. Army, is being undertaken in two stages. The first stage, building of the new riverward lock while the old landward lock is kept in operation, is completed. The second stage, building of the new landward lock while the new riverward lock carries the traffic, is now in progress.

Locks No. 2 are at Braddock, Pa., a suburb of Pittsburgh, on the Monongahela River at a point 11.2 miles above its mouth. These locks are now the first navigation structures above the mouth, since the Locks No. 1, originally located about 8 miles downstream from Locks No. 2, were rendered unnecessary in 1937 by improvements in the navigable-water depth.

The old Locks No. 2, completed in 1906, consisted of twin parallel structures with lock chambers 56 ft wide and 362 ft long. The lock walls were supported on wooden piles driven into a gravel foundation. The structures were built with natural-cement concrete, apparently placed in layers about 12 in. thick. After about 45 years of service, the condition of the concrete, although varying considerably in different parts of the structure, was generally poor. This condition, the obsolescence of the mechanical equipment,

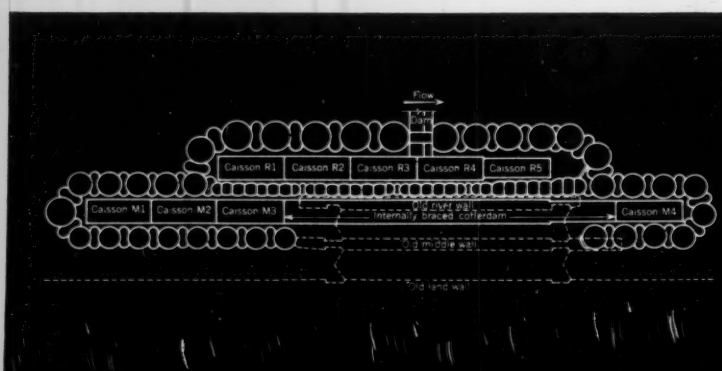
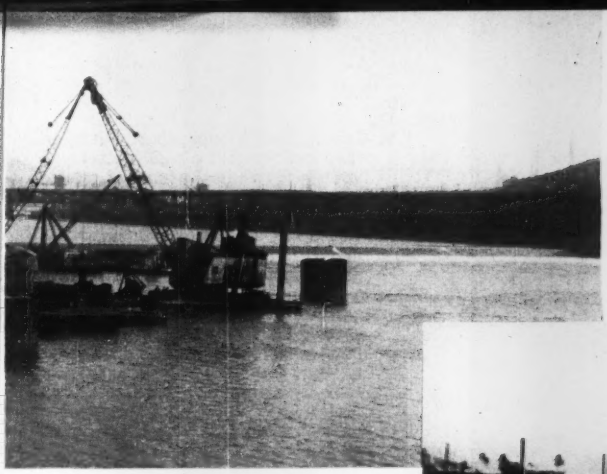
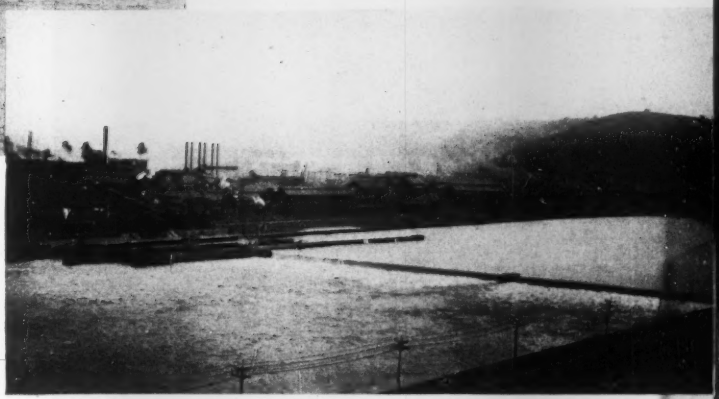


FIG. 1. FIRST-STAGE COFFERDAM for construction of new riverward lock utilized old middle wall, specially braced.



NEW RIVERWARD LOCK is seen under construction in first-stage cofferdam (left) while old landward lock passes river tow. Need of keeping one lock always in operation cut off contractor's land access and required assembly of equipment and materials by water.

HEAVY INDUSTRIAL USE of river banks, seen in view of old locks (below) was chief determining factor in location of new locks at same site as old, although construction problems were thereby complicated.

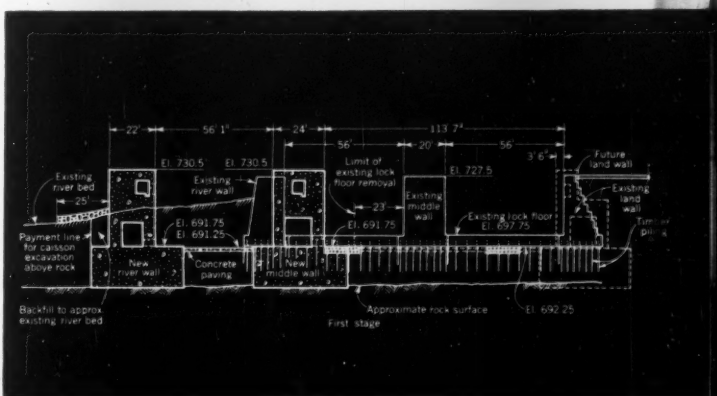


Locks No. 2

and the poor condition of the foundations, made replacement of the locks essential if extraordinary measures for keeping them in service were to be avoided. Furthermore, the capacity of these locks was inadequate for present-day river traffic.

Old Site Found Most Economic

When it became evident that the locks had to be replaced, many months were devoted to detailed studies of the problem. The first and most important item to be decided was the location of the new



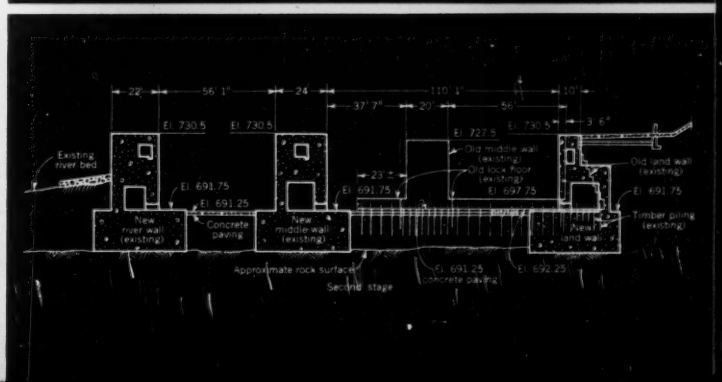
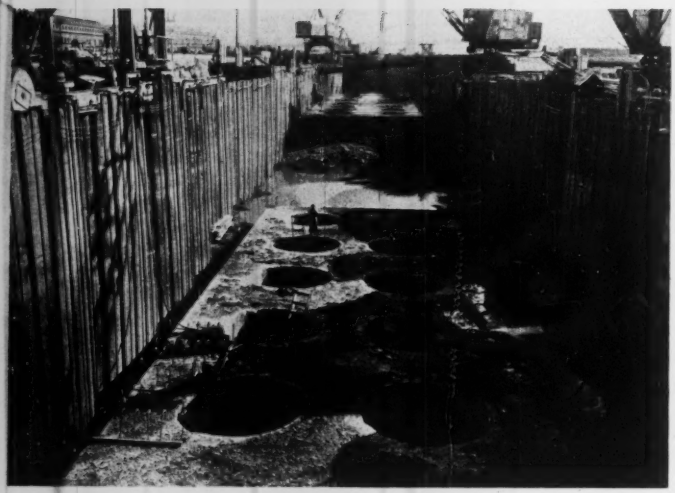
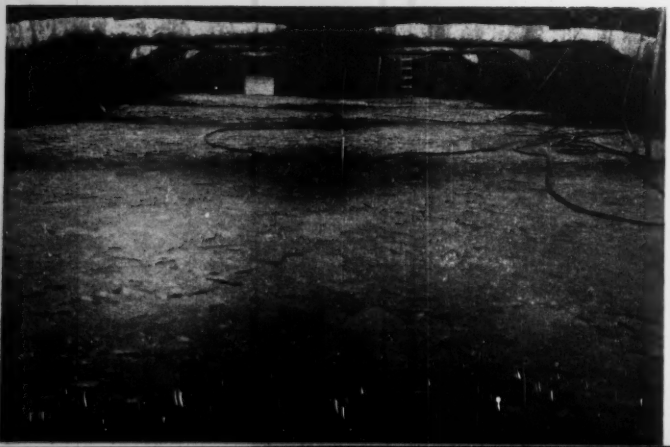


FIG. 2. CONSTRUCTION of new Locks No. 2, Monongahela River, is carried out in two stages. First stage (top) consisted of demolition of existing river wall and building of new river wall and new middle wall for riverward lock in first-stage cofferdam. Second stage (below), now under way, consists of demolition of old middle and land walls and construction of new land wall and appurtenant facilities in second-stage cofferdam.





locks. The Monongahela River in the vicinity serves a highly developed industrial area in the heart of greater Pittsburgh. Industrial plants and railroads are adjacent to both banks. There are also numerous river terminals for handling coal, coke, sand and gravel, cement, iron, and steel as well as other river commerce.

A large amount of industrial water is derived from the river. Water intakes and sewer outlets of large capacity have been provided in relation to existing pool elevations. The Pittsburgh, McKeesport and Youghiogheny Railroad, the Baltimore and Ohio Railroad, and the Union Railroad are on the right bank. On the left bank are the large river rail terminals of the Union Railroad, beginning about a half mile upstream from the locks and continuing upstream for more than a half mile. There are several river terminals immediately downstream from the locks. Immediately above and below the locks, the Edgar Thompson Works of the U.S. Steel Co. has large water intake and discharge facilities.

Approach Difficulties Further Upstream

Any change in the location of the existing locks was further complicated by the fact that Turtle Creek, a tributary coming into the Monongahela River approximately a half mile above the site, produces heavy flows after severe local rains over its watershed, which would cause serious approach difficulties to any lock located closer to its mouth than the present Locks No. 2. It was therefore decided that the most feasible and economical location for the new locks was the site occupied by the existing locks.

The exact location of the new lock walls with respect to the old ones was determined mainly by physical conditions at the site and by the necessity for maintaining river traffic. The location of the new middle wall had to be riverward of the old middle wall so that the old landward lock could remain in operation while the new riverward lock was being constructed. Also, the new middle wall had to be as close to the old wall as

CAISSONS for new river wall of riverward lock were 116 ft long. Top view, of one caisson under construction, was taken September 28, 1941. Middle view, showing outside concrete in place on caissons, was taken November 7; and bottom view, inside one of open caissons, showing foundation ready for concrete, was taken February 15, 1950. In all, five caissons were required for new river wall.

possible since the river channel is narrow at the site and the new locks must encroach on the flood channel to the least possible degree. With the position of the new middle wall thus fixed, the location of all walls was established (Figs. 1 and 2).

Construction by Cofferdam and Caissons

It was necessary for the existing middle wall to serve as an arm of the riverward cofferdam for construction of the new riverward lock. With the top of the cofferdam high enough to permit continuity of operations, studies showed that the wall would be loaded to dangerous limits, especially in view of the known questionable condition of its foundations. Even with the top of the cofferdam at an elevation so low as to be exceeded by flood stages on an average of nine times a year, the forces acting on the wall were found to result in horizontal, vertical and withdrawing loads on the supporting piles in excess of desirable values. In view of the shallow depths to which the piles were driven and the fact that a major wall failure would completely stop navigation, the assumptions had to be conservative. It was therefore concluded that it would be unsafe to employ the existing middle wall as a cofferdam arm unless external support were provided.

Various schemes for providing the needed support were studied. All had the drawback that they required alternate supporting and construction operations in short sections with much moving of supporting members and interference with rapid construction progress. With movements limited to a single lock, congestion and delay to river traffic was unavoidable during the construction period. It was therefore essential that construction be carried out as rapidly as possible.

Open-cut methods for the construction of most of the new middle wall and that part of the new river wall adjacent to the existing dam were not feasible because of the danger of undermining the pile-supported old middle wall and the dam. Therefore these new lock walls had to be constructed either by caissons or by internally braced cofferdams. These methods were logically extended to all parts of the walls that were founded on rock.

Design Follows Standard Pattern

The lock design followed, in general, the standard pattern for structures of this nature on the Ohio River and its tributaries. The new river wall contains the facilities for filling

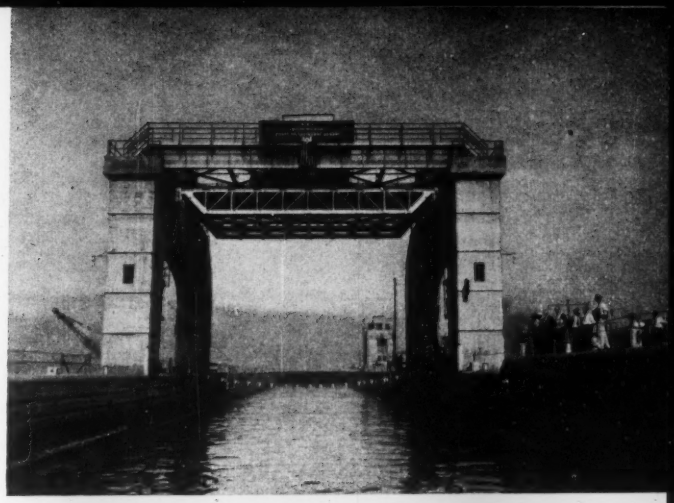
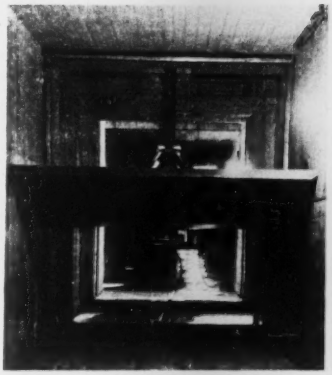


PHOTO TAKEN from upstream on day new riverward lock was opened to traffic shows floodway bulkhead in center foreground, suspended in horizontal position from overhead structure.



DOWNSTREAM BUTTERFLY VALVE, seen in open position in gallery of new river wall, is similar to valve located near upstream end of gallery. Similar gallery and butterfly valves are incorporated in new middle lock wall and will be incorporated in new land wall.

BY SUPPORTING old middle lock wall with struts, contractor was able to use it as part of first-stage cofferdam. See cofferdam arrangement in Fig. 1.

and emptying the new river lock. These facilities include intake ports at the upper end of the wall, a gallery approximately 12 ft high and 13 ft wide running the full length of the wall, and discharge ports at the downstream end of the wall. Ten outlets running from the culvert to the lock chamber, are spaced through the length of the lock chamber. Butterfly valves are located at the upper and lower ends of these outlets. By coordinating the operation of these valves with that of the upper and lower lock gates, it is possible to fill and empty the lock chamber by gravity flow. The new middle wall contains similar filling and emptying provisions for the new 110-ft-wide landward lock, the design of which is discussed more fully later.

Near the top of the new walls is a gallery approximately 6 ft wide and 6 ft 6 in. high, in which are located the oil lines for the hydraulic operating machinery and the cables of the electric system.

Flow Obstruction Compensated

As has been mentioned, the river is fairly narrow at the lock site and the valley upstream is highly industrialized. Flood stages are therefore a matter of grave concern, and one of the conditions of the design was that the new construction should not contribute to increased flood stages upstream. Since the new construction extends some 60 ft further into the river than the old structures, it was necessary to devise some means of counteracting this increased obstruction to flow. Furthermore, it was considered desirable to provide some means for emergency closing of the lock in case an accident should damage the lock gates.

To meet these needs an emergency bulkhead was designed and constructed just upstream of the upper lock gates. The structure consists of two piers, one on the river wall and one on the middle wall, with a bulkhead spanning between the piers. Operating very much on the principle of overhead garage doors, the bulkhead can be lowered to form a dam across the 56-ft lock just above the upper gates.

Standard miter-type lock gates cannot be operated against any substantial head. Therefore it would have been impossible to open both the upper and lower lock gates simultaneously without some provision for blocking the flow through the lock while this was being done. With the new bulkhead, however, the procedure when extreme flood stages threaten is simply to lower the bulkhead, open the upper and lower lock gates and then raise the bulkhead, thus providing a free chute through the lock for the flow of the river. This chute capacity more than offsets the loss of river-flow capacity resulting from the fact that the new locks are wider than the original ones. Normally, the bulkhead is stored in a horizontal position spanning the lock at an elevation high enough not to interfere with traffic through the lock. No such bulkhead is contemplated for the landward lock.

Bids for the new river lock were opened on November 23, 1948. This work included the construction of the new river wall, the new middle wall and all facilities necessary for placing the lock in operating condition. This lock is 56 ft wide and 360 ft long. The Dravo Corporation of Pittsburgh, which was the low bidder with a bid of $7,263,136, started work on December 28, 1948, and completed it in June 1951.

The contractor elected to use the cofferdam method of construction with a combination of internally braced cofferdam and open caissons within the general confines of his over-all cofferdam.

Access by Water

Access to the work was restricted and practically all materials had to be moved in by water. The only land access was a secondary road running through the storage yard of the U.S. Steel Co. This road had only limited clearances and was not suitable for heavy truck traffic. Furthermore, it would have been difficult to establish any satisfactory method of transporting materials brought in by land across the operating lock to the construction site. Consequently, the contractor set up the job and prosecuted it successfully using the river almost exclusively for the transportation of equipment and materials.

Different Problems on Landward Lock

New and different problems had to be resolved in designing the land lock. This lock, which is 110 ft wide and 720 ft long, will permit 13 standard Ohio River barges and a towboat to pass through at one time, a tremendous increase over the present capacity.

As has been pointed out, the middle wall, which serves both locks, was constructed under the first contract. The second contract, now in progress, consists of constructing the new land wall and the upper and lower sills, setting the lock gates, and performing such other construction as is necessary to put the new land lock in operating condition. Dravo Corporation was low bidder on this lock also, at a bid price of $7,967,667.

The new land wall is similar in design to the other walls. It contains a culvert which, together with the culvert in the new middle wall, constitutes the means for filling and emptying the landward lock. The land wall also contains a pipe and electric-cable gallery near the top, similar to the galleries installed in the other walls.

The principal difficulty was that of retaining the material back of the new land wall during construction. Explorations of the bank revealed the presence of highly plastic, black, silty clay. Because of extensive main-line railroad and yard tracks immediately landward of the construction, extreme caution during excavation must be exercised. Furthermore, the presence of major facilities of the U.S. Steel Co. floating in this zone requires that the zone be preserved in a stable condition during construction.

There is insufficient room between the railroad tracks and the new wall to permit excavation of the plastic clay on a stable, unsupported slope. The design therefore calls for a row of bank-supporting steel sheetpiling cells to prevent disturbance of this clay and of the bank during reconstruction. Downstream from the plastic clay, which runs only about halfway along the length of the new lock, excavation slopes in the granular artificial and natural fills found in the bank are unprotected.

The Reconstruction of Locks No. 2, Monongahela River, has constituted one of the more interesting design and construction problems encountered in the Pittsburgh area and has attracted considerable attention both from engineers and from navigation interests. When completed, the new construction will offer a modern, adequate navigation facility that should serve the Pittsburgh area for many years.

R. A. Thompson is General Superintendent for Dravo Corporation on the project. The work was designed and the construction is being performed under the supervision of the District Engineer's Office, Corps of Engineers, U.S. Army, Pittsburgh, Pa. Colonel Conrad P. Hardy, M. ASCE, is District Engineer; R. W. Comfort was Resident Engineer for the first contract, and E. P. Dougherty is Resident Engineer on the second contract. The writer is Chief of the Construction Division for the Pittsburgh District.

MOST irrigation projects now under construction or planned in Ceylon are based on ancient works. One of oldest of these still in use is Kala Wewa reservoir and spillway (top) which dates back to fourth century B. C. Ancient methods of construction are also still used, illustrated by elephant (lower left) employed to pull boulders from canal bank. In ancient times elephants may also have furnished motive power for outlet gates. One of great reservoir builders of Ceylon was twelfth century king, Parakrama Bahu, whose statue in solid granite (lower right) stands near reservoir of Topa Wewa, said to have been largest of ancient reservoirs, covering 6,000 acres. Example of this great builder and restorer of irrigation works is being followed by island's present Irrigation Department.

Ceylon restores its ancient irrigation works

PAUL von der LIPPE,
Assoc. M. ASCE

Technical Adviser, Ministry of Agriculture and Lands, Government of Ceylon, Colombo, Ceylon

THE ROLE of irrigation in Ceylon's agriculture in recent years has become of increasing importance to the island's population of seven million. Through archeological exploration, begun about 75 years ago, and reconnaissance surveys by the island's Survey and Irrigation Departments, extensive irrigation developments constructed centuries ago have been discovered and are now being restored and utilized in the expanding agricultural undertakings of the country. This article describes briefly a few of the ancient irrigation works and their importance in the integrated agricultural economy of present-day Ceylon.

IN CEYLON there is little underground water, so that supplies for irrigation must be obtained from the watersheds, streams, and rivers. The island as a whole is founded on Archean crystalline schist and various types of intrusions of deep-seated igneous origin. Only on the Jaffna Peninsula, which is a coral formation at the northern tip, are wells used extensively for irrigation. Although the greater part of the island is less than 500 ft above sea level, the south central part contains peaks such as Mount Pidurutalagala, which rises 8,281 ft above sea level.

Seasonal changes are caused by the monsoons, as the island lies in the path of both the southwest and the northeast monsoon. The former usually starts in May, is in full force by June or July, and is over by September. In this period about 40 in. of rain falls on the west coast. The fall is heaviest in the mountains, where it averages 80 in.; on the southeast, east, and northern part of the island, the average is about 20 in. The northeast monsoon starts in October, when heavy downpours sweep in from the Bay of Bengal, and lasts through early January. The fall is heaviest in the hills on the east side of the island, averaging 40 in. during these months.

The island has one wet zone where the rainfall is from 75 to 200 in. and above per year. There are two dry zones, the southeastern and eastern coast zones, and the entire northern part of the island, where the rainfall varies from less than 50 to 75 in. per year. Extensive droughts and floods occur in the dry zones, where during a period of 10 successive years, rainfall is usually deficient for irrigation for 2 or 3 years, excessive for 1 or 2 years, and sufficient for the remaining 6 or 7 years.

The wet zone is the most fertile on the island, and here tea, rubber, coconut, and cocoa grow without irrigation. Rice, however, requires irrigation, and for it small diversions from the streams and village reservoirs are utilized. The plains areas suitable for rice cultivation are in the dry zones, and since the rainfall, which at first glance seems ample, is concentrated over a few months only, irrigation is required to sustain this type of agriculture. Evidence that irrigation has always been required is found in the remains of numerous extensive ancient irrigation works.

The violent cyclonic rain storms to which Ceylon is subject may have been the cause of the final destruction of these ancient irrigation works. In 1897, for example, a rainfall of 31.7 in. in 24 hours is reported to have destroyed more than 160 reservoirs as well as roads, dwellings, and bridges. Lack of sufficient data on these storms complicates modern engineering design, although rain gaging is now more reliable, 500 stations having been established throughout the island.

Two methods of irrigation were used in ancient Ceylon. One was to store water in reservoirs, utilizing earth embankments as dams and depending on the catchment for the water supply. From the reservoir, the water was distributed either

directly to the fields through primitive outlets in the embankment, or through canals. In the other system, part of the flow of a river was diverted into canals which carried it to fields at a considerable distance. To permit the diversion of larger quantities of water, temporary or permanent diversion dams were constructed.

The first irrigation works were what are known as village "tanks" (from the Portuguese *tanque*, or lake) which varied in size from 2 acres to 100 or more, depending on the water supply, the topography, and the requirements of the village. The water from these tanks was distributed equally among the villagers. The disadvantages of the village tanks were numerous. They were more expensive to construct than a few larger tanks would have been, and often they were not filled because the watershed was not adequate. It was important to have the tank near the village, and frequently not enough care was taken in selecting a good site for it. Most of the small tanks were shallow, and it was not uncommon for half the storage to evaporate.

Later, when the art of building tank embankments or "bunds" was mastered, larger works were undertaken. Lengths of embankments extended up to 9 miles and heights up to 50 ft and more.

Earliest Reservoirs Probably Built in Fourth Century, B. C.

Panda Wewa, on the west coast (Fig. 1), may have been the first of the larger reservoirs to be built—probably in the fourth century, B. C. According to an inscription cut in the stone at the outlet works, it was repaired by a twelfth century king, who was responsible for the restoration of many other huge irrigation works. The embankment was breached early in the last century.

The embankment for the Panda Wewa tank was carried in a north-south line across the river, then southwesterly in order to butt up against a large 250-ft-long flat rock. From the south side of the rock, the dam continued in a southerly direction and then swung upstream for approximately 2,000 ft until high ground was reached. A considerable amount of earthwork was saved by the change in the alignment of the dam. It is obvious that the valley had been carefully examined since the site was chosen to take advantage of the large rock to provide a safe spillway.

As the reservoir seems to have remained intact until the twelfth century, it would appear that the height to which the floods would rise over the rock had been correctly estimated. The embankment is 1.6 miles long and 22 ft above the sill of the outlet works, which must have been installed at a later date. The crest of the spillway was 13 ft above the outlet sill. An additional storage depth of 2 ft was provided later by a temporary dam, or possibly flashboards, erected between short stone pillars across the spillway. The top of the earth embankment was 8 ft wide, and the side slopes were $2\frac{1}{2}$ horizontal to 1 vertical. Later, experience taught the ancient engineers the advisability of adopting a wider top width and flatter embankment slopes. A layer of small boulders was placed, perhaps at a later date, on upstream slopes to protect against wave action. Such protection is found on all the larger embankments.

One rectangular culvert of the outlet works was constructed on low ground adjacent to the stream and another at a high level near the north end of the embankment. When the reservoir level was about 13 ft over the sill of the outlet, the water surface covered 1,050 acres, forming a reservoir of 7,200-acre-ft capacity.

Although this tank is surpassed in size by others, especially later ones, it is impossible not to admire the ingenuity of the early engineers who had the courage to construct a dam across a valley where floods of considerable volume had to pass. The average annual rainfall in the valley is about 85 in., and the maximum flood may amount to 14,000 cfs.

Pavat Kulam Tank, in the northern part of the island, where the average rainfall is 50 in. a year, is also believed to have been built in the fourth century, B. C. The dam was 1.8 miles long, and the distance from the sill of the lowest outlet to the spillway crest was 18 ft. The embankment was 28 ft high, and the crest of the dam was 8 ft above the maximum water level of the reservoir. The embankment slope on the upstream face was 3.2 horizontal to 1

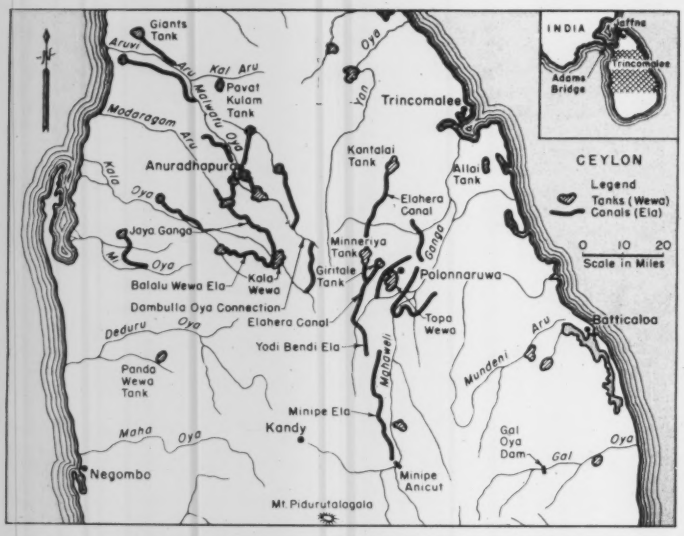


FIG. 1. CEYLON hangs like a pearl drop at end of coral reef chain called Adams Bridge, extending from India's southern cape. Ceylon is about 270 miles long from north to south, and has area of 25,000 sq miles.

DIVERSION DAM, called Minipe Anicut, on Mahaweli Ganga, Ceylon's largest river, diverted water into Minipe Ela (canal) for irrigation of large areas on left bank of river.

vertical, and on the downstream face, 2.6 horizontal to 1 vertical. By that time engineers were evidently beginning to realize that it was unnecessary to make the slope of the downstream face as flat as that of the upstream face. The upstream slope was, as usual, protected with small boulders and wedged rubble, extending downward from the water surface.

Three spillways were provided. The one at the southern end was 125 ft long, in line with the embankment. Its floor and ends were covered with large wedged slabs of carefully laid stone, those on the floor occupying a transverse width of 60 ft. The spillway was provided with a series of pairs of stone pillars, by the aid of which a temporary dam of logs and earth could be raised after the flood had passed, thus assuring an additional 2 ft of storage. A road bridge of stone slabs laid on stone pillars made it possible to cross the spillway during discharge. There were two more spillways at rocky sites, one 28 ft and the other 100 ft wide. These spillways were evidently insufficient because the embankment has been breached in three places. Water from this reservoir must have been used extensively as there were four outlets, or sluices, besides a culvert under the floor of the southern spillway.

Elephant-Powered Outlet Gates

The outlet works, or *bisokotuwa* ("the enclosure where the water level lowers") were all of similar construction (Fig. 2). There were three parts:

1. An inlet culvert, usually a single barrel, by which the water is led through the embankment, and which may have head and wing walls to suit the embankment slope.

2. A rectangular open gate well leading from the culvert and constructed near the point where the maximum water surface in the reservoir intersected the upstream slope of the embankment. This well was usually about 11×8 ft, with the small dimension along the axis of the culvert.

3. One or two discharge culverts leading from the well to beyond the downstream slope of the embankment. Here again, head and wing walls were constructed to suit the slope of the embankment.

Outside the rock lining, against the embankment, there were usually brick walls from 5 to 6 ft thick, for stability. Outside the brick walls it is supposed that there was also a puddled clay backfill about 2 ft thick, to prevent creep and also, probably, leakage.

Rock for the lining of the culverts was usually gneiss 12 to 15 in. thick. Ancient tools which probably were utilized in quarrying the rock have been found, including hand drills, mason's chisels, picks, hammers, and various other implements. Rock slabs found among the ruins contain holes which indicate that they were mined by means of a set of drilled holes. Then steel or hardwood wedges were utilized to build up enough pressure to break out a length of slab.

One ancient *bisokotuwa* was discovered by the writer during a reconnaissance for a proposed dam site. These outlet works were well preserved; the invert, sides, and roof were constructed of well-fitted rock slabs still perfectly even and plumb. There were no recesses or holes, such as are usually found in similar structures, for attaching framing for timber gates. Two outlet culverts were $2^{1}/_{3}$×3 ft, and one single-barreled inlet culvert was 4×4 ft. What lifting arrangement was employed for these gates can only be surmised, but it is possible that elephants furnished the motive power. It is probable that elephants were utilized also to lift the 5-ton rock slabs used in the embankments and culverts.

Ancient Irrigation Works Still Usable

The area around Anuradhapura, ancient capitol of Ceylon, is drained by three rivers running to the west coast and having a combined watershed of close to 3,000 sq miles. They are the Malwatu Oya, the Modaragam Aru, and the Kala Oya. All the irrigation works in this area are closely linked with these rivers, though they have their origin in the huge twin tanks, Kala Wewa and Balalu Wewa. Kala Wewa was built in the fourth century, B. C., to supply the capital, 54 miles away, with water and to help the farmers irrigate their lands. The second reservoir, Balalu Wewa, was constructed later. These two tanks have a combined capacity of 72,700 acre-ft. Their spillway is shown in a photograph.

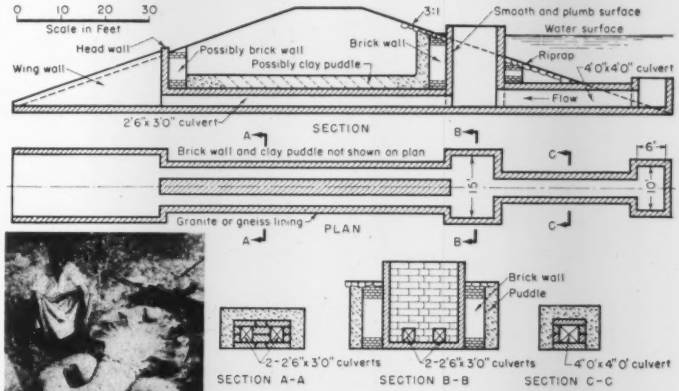


FIG. 2. TYPICAL OUTLET WORKS for ancient reservoirs on Ceylon, dating back to 300–400 B. C., show careful design and construction details. Carved image of cobra (left) is found at many ancient outlets, apparently placed there as sacred guardian of the water.

MOST IMPRESSIVE of all ancient canals in Ceylon's eastern watershed is 1,600-year-old Elahera Canal, about 85 miles long. Structure shown at left splits Elahera Canal into two parts for diversion to Minneriya and Giritale Tanks (reservoirs). At right is outlet from Minneriya Tank to the canal. Irrigation Department of Ceylon is now restoring 20-mile reach of canal from Minneriya Tank to Kantalai Tank.

From this twin reservoir emanated two main canals, the Balalu Wewa Ela and the Jaya Ganga. The Balalu Wewa Ela irrigated lands in the driest part of the province for a distance of approximately 15 miles, connecting with the Kala Oya at another tank. The Jaya Ganga carried water the 54 miles to Anuradhapura, where it fed and still feeds two tanks. After supplying the city with water, the Jaya Ganga carried the surplus along the west bank of the Malwatu Oya for several miles. This canal, an outstanding example of ancient irrigation engineering, was 40 ft wide and today has a capacity of 250 cfs. It meanders in easy curves and has a bottom gradient of only 6 in. per mile for the first 16 miles, although a gradient of about 1 ft per mile was most common in the ancient canals.

Farther down the Malwatu Oya, or Aruvi Aru as it is called near its mouth (Fig. 1), there were two schemes for diverting the river water into canals. One, on the right bank, led to the Giant's Tank, which had embankments about 6 miles long and was shaped like a triangle having a wide curve in front, making it possible to irrigate land on both sides of the tank as well as in front. Although the supply canal was started from both ends, it was never completed. The grades have been checked and found to be reasonably accurate. The total length was $11\frac{1}{2}$ miles and a drop of only 12 ft was available.

Use of Leveling Device Indicated

The fact that work on different sections went on at the same time refutes the contention that the ancients were only able to construct their canals with such precision and flat gradients by bringing the water along with them as they excavated. They must have had some kind of a leveling device, perhaps a primitive arrangement of two clay pots connected by a long tube and filled with water.

More impressive was the second scheme mentioned above, which diverted water from one watershed to another to augment the supply to Anuradhapura. A stream from the watershed most affected by the southwest monsoon was diverted through a large cut in a saddle to pass down the Dambulla Oya which feeds the Kala-Balalu Wewa. This link probably made the entire scheme practicable.

In its magnitude and in the foresight exercised in its design, the system for irrigating large areas around Anuradhapura compares favorably with modern storage and irrigation works. It is not certain, however, that the various links and diversions functioned at the same time. There were periodic invasions by enemies, and undoubtedly many tanks and canals were destroyed at such times. It is likely that irrigation works thus destroyed were not restored.

The eastern watershed of the island also has extensive irrigation developments. The main river in this region, Ceylon's largest, is the Mahaweli Ganga (Great Sandy River), which has its headwaters in the mountains. The lower reaches receive additional water from the northeast monsoons. Where the Mahaweli Ganga leaves the mountains for the plains, it rushes through a narrow gorge and turns northward. At the bend called the Minipe Anicut are ruins of an ancient overflow dam, behind which the river was backed up to a considerable height. A canal, the Minipe Ela, was utilized to irrigate large tracts of land on the left bank.

The most impressive of all the ancient canals in this region is the 1,600-year-old Elahera Canal, a continuous waterway about 85 miles long, which carried water to lands near Trincomalee. The canal is remarkable in many respects. It begins in a dense forest region and intercepts many streams from the hills above. At the stream crossings, riprap protection was provided on the bottom of the canal as well as on the inside face of the embankment. Several rock spillways were placed at intervals in the embankment. Some of these spillways are 50 ft wide and provided with substantial wing walls. The culverts which permitted irrigation water to be distributed to the fields below the canal were built of cut rock. The average height of the canal embankment is 15 ft but in places it is 30 to 35 ft high. At many points, the canal runs between double embankments. Twenty-five miles from the point of diversion, the canal passes into the Minneriya Tank, and a branch canal goes to the Giritale Tank. From the Minneriya Tank, the Elahera Canal continues for another 20 miles to feed a large reservoir called the Kantalai Tank.

Another great tank, Topa Wewa (also called the Sea of Parakrama), near the city of Polonnaruwa, is claimed to have been the largest tank constructed in ancient times, and to have submerged an area of 6,000 acres. The embankment of this tank is nearly 9 miles long and has an average height of 40 ft above the original ground level. The berm is 20 ft wide at the top. There seems to be some uncertainty as to the date of its construction, but it is believed to have been restored in the twelfth century. This great tank has recently been again restored by the Irrigation Department of Ceylon and now has a storage capacity of 98,000 acre-ft. It is capable of irrigating 20,000 acres in each of the two monsoon seasons.

Modern Ceylon Is Erosion Conscious

Following invasions and near destruction of the ancient Ceylonese civilization by armies from India, the cultivation of irrigated lands diminished for a number of reasons. Farmers and tank builders had to be diverted to fight the invaders, and many tanks and canals were destroyed or abandoned by the people, who sought refuge in the hills. Eventually it became necessary to import rice from India and Burma. Following the great malaria epidemic and famine of 1934–1935, the importance of repairing the ancient irrigation works and expanding rice production became increasingly evident.

There have been other changes closely associated with irrigation. In the nineteenth century tea was found to be a very profitable crop. As the best tea is grown on the highest and steepest hills, the dense jungle and forest-clad mountainous areas were stripped of their luxuriant vegetation. Soil erosion was invited by neglect of contour and terrace cultivation, and weeds and grass under the tea bushes were eventually eliminated. Now, however, Ceylon has become erosion and flood conscious, and there is a law prohibiting tea plantations above an elevation of 5,000 ft. But the damage has already been done; the monsoon torrents rush down the hillsides carrying soil and debris to the rivers, increasing the flood hazard by building up sand banks in the rivers and sand bars at the river outlets. Many streams which once flowed continuously are now dry during parts of the year.

For these reasons the Irrigation Department of Ceylon is interested in restoring the ancient irrigation tanks. It must plan for the whole island and take into consideration the land available, the supply of water, and the distribution of the population. There is also much to be done in the way of flood control and hydroelectric development, which could ultimately change the entire standard of living on the island. Most of the projects now under construction or planned can be based on the ancient works, and with these for assistance and inspiration, Ceylon can continue to maintain her reputation for irrigation.

Ceylonese learn American methods quickly on Gal Oya Dam

D. J. BLEIFUSS, Assoc. M. ASCE
Chief Engineer, International Engineering Co., Inc., San Francisco, Calif.

CEYLON'S Gal Oya Project is intended primarily to irrigate about 120,000 acres, but also serves to control floods and to provide some power. The dam is located on Gal Oya (Rock Creek) in the Eastern Province of Ceylon, about 22 miles from the east coast as the crow flies, at about 7-deg 12-min north latitude. (See map, page 42.) Its construction has combined the use of modern American methods with the training of previously unskilled local labor in the operation and repair of American heavy equipment.

Ceylon is a green and beautiful island. In the lowlands the temperature is very much like that in the Panama Canal Zone, although subject to slightly more variation, going as low as 65 deg F and as high as 100 deg F. The humidity is quite high. Racially, the people are of three main stocks, Cinghalese originally native to Ceylon, Tamils who came from India in various invasion waves, and European.

Since 1947, Ceylon has been an independent member of the British Commonwealth of nations, with about the same status as Canada. Prior to that, it was either partially or completely under European domination for over three hundred years, first under the Portuguese, then under the Dutch, and finally under the British. Because of this long exposure to European ideas, living standards generally are higher and the people generally more advanced than anywhere else in Asia outside of Japan and the Philippines. Buddhist, Hindu, Christian and Mohammedan religions have the greatest number of adherents in the order named.

The people are intelligent, quick to learn and eager to learn. On the Gal Oya Project, men with no previous experience with heavy construction equipment in a very short time have become competent operators of power shovels, crawler tractors, elevating graders, large Euclid trucks and other equipment. The success of this training program is best illustrated by the fact that on this project there have never been more than 66 Americans, including construction, accounting, administrative and engineering personnel. The American personnel were carefully selected, and have worked hard and efficiently, but if the people of Ceylon had not been receptive and capable, the present achievement would have been impossible. All the Ceylonese lack is training and experience. On the work here described quite a large number of them have obtained training which should be of inestimable value to Ceylon. However, one large job is not enough to develop men with the experience and ability to organize and direct a large construction operation. Experience in the United States has shown that such men are developed only by working through several large operations.

Jungle Covered Entire Dam Site

Where not kept back by continual cultivation, the jungle covers everything in Ceylon. The site of a great city, Polonnaruwa (see map, page 42), was lost for centuries in the jungle, although the extent of the ruins of the marvelous ancient structures indicates that once it must have had a population of over a million. The jungle abounds in birds and game. In the vicinity of the Gal Oya Project there

BEDROCK at dam site is granite gneiss in form of dome-shaped hummocks.

SOD for protecting downstream face of dam was obtained from shores of existing tanks (reservoirs) nearby. Frequent rains seriously hampered work of slope protection.

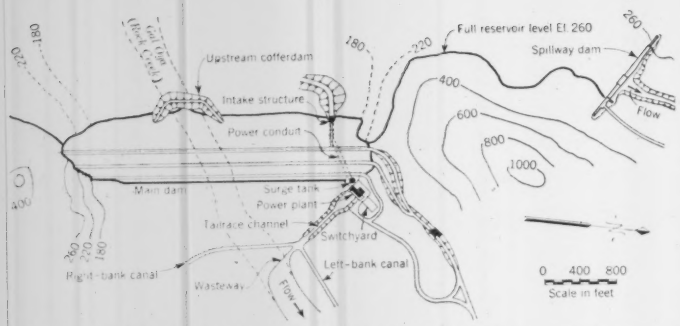


FIG. 1. MAIN DAM of Gal Oya Project rises about 120 ft above valley floor. Structure is 3,600 ft long and contains 5,000,000 cu yd of earth fill.

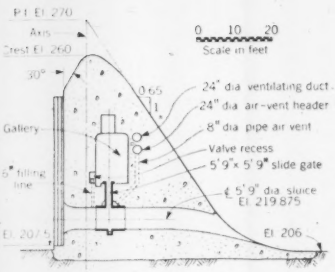


FIG. 3. SPILLWAY CROSS SECTION shows concrete gravity structure at lower end, where crest is at El. 260.0 for length of 120 ft.

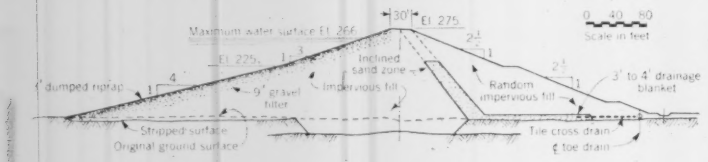


FIG. 2. CROSS SECTION of main Gal Oya Dam indicates location of sand zone. Original plan called for semipervious zones on each side of impervious core but explorations revealed that pervious material was scarce and expensive to obtain. Design was therefore changed to that shown.

are wild elephants, leopards, deer varying from the tiny mouse deer to quite large species, monkeys, and many other animals. The small bears deserve special mention. They are vicious, and will deliberately stalk and attack a human being alone in the jungle. When the work started, the project site was entirely covered by the jungle.

Dr. John L. Savage was engaged as a consulting engineer by the Government of Ceylon in 1946. In 1947, the Department of Irrigation entered into a contract with the International Engineering Co., Inc., to prepare contract drawings and specifications, and Richard Kahawita was sent to the United States to represent the Government of Ceylon while this work was being done. In 1948, the Department entered into a contract with Morrison-Knudsen International Co., Inc., to construct the project, and a little later into a second contract with the International Engineering Co. for the preparation of detailed designs and specifications.

Construction men and equipment were moved in to the site early in 1949, and work started immediately. Progress has been good. The spillway dam is already completed; the main dam is to be completed in August or September of 1951 and the powerhouse a little later. In February 1951, the construction contract was amended to include seven miles of the left-bank canal.

The Gal Oya Project involves the creation of a reservoir by the construction of a main earth-fill dam, a gravity-type concrete spillway dam, and several small earth dikes, with facilities for the release of irrigation water and for the generation of power. (See Fig. 1.) The dominating feature of the landscape is Mt Inginiyagala, about 900 ft high, rising abruptly and alone from the surrounding flat lands, and forming the left abutment of the main dam.

The main dam (Fig. 2) rises about 120 ft above the general level of the valley floor, is about 3,600 ft long, and contains about 5,000,000 cy yd. Under the central third of the dam, all overburden and weathered rock were removed. The bedrock thus exposed is a granitic gneiss in the form of dome-shaped hummocks.

A trench 10 ft deep dug in this foundation rock had been planned with a reinforced concrete core wall in the center of the trench and extending up into the impervious fill for 10 ft. This core wall would have been a difficult thing to build, because of the variations in elevation of the rock domes. The rock proved to be so sound that the core wall apparently was not necessary anyway, so the idea was abandoned. The Government, however, insisted on short lengths of core wall at each abutment.

Carefully compacted impervious material was placed on this exposed rock in the center third of the foundation to form the core of the dam. The zones outside the core, both upstream and downstream, were intended to be made of compacted semipervious material. However, extensive investigations made by the contractor immediately after moving in, showed that the overburden in the area was the weathered residual of the gneiss, and that it was all impervious. The only pervious material to be found was the coarse sand in the existing river channel, and this was expensive to get, since it had to be dredged by dragline. The design of the dam was therefore changed to introduce drainage zones of the pervious river sand. Under the downstream third of the dam, all vegetation and top soil were removed, and a layer of sand 3 to 4 ft thick was placed on the clean overburden, from which an inclined zone of sand was extended upward (Fig. 2). The horizontal layer is drained by a system of concrete tile. These drainage zones will keep the line of saturation well away from the downstream surface.

Under the upstream third of the dam, also, all vegetable matter and top soil were removed, but the fill was deposited directly on the clean overburden.

From the construction standpoint the disintegrated gneiss is an ideal material. It is structurally strong, with an angle of internal friction of 35 deg. It is tight, and the frequent rains do not make the borrow pits

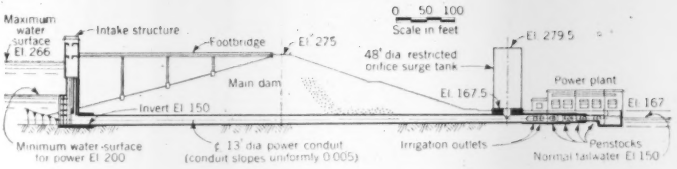


FIG. 4. WATER OUTLET for irrigation and power is dug in solid rock. Pipe is completely surrounded by reinforced concrete designed to take load of dam and external water pressure when empty.

TABLE I. UNITS COSTS OF GAL OYA PROJECT

Clearing and grubbing borrow areas, per acre	$175.20
Excavation, all classes, for foundation of main dam, per cu yd	1.33
Excavation, common, in borrow areas, and transporting, per cu yd	0.37
Placing earth fill in dam, per cu yd	0.167
Sodding downstream slope of main dam, per sq yd	0.80
Diamond drilling for grouting, between 20 and 50-ft depths, per lin ft	4.59
Mass concrete, per cu yd	24.66
Reinforced concrete, intake structure, exclusive of steel, per cu yd	59.98
Reinforced concrete around steel water conduit, exclusive of steel, per cu yd	31.51
Concrete in powerhouse substructure, exclusive of steel, per cu yd	37.53
Furnishing and placing of reinforcing steel, per lb	0.128
Furnishing and placing of steel water conduit, per lb	0.198
Furnishing and placing of surge-tank steel, per lb	0.202

or fill muddy. Water quickly runs off, and work can be resumed half an hour after a rain.

On the downstream face of the dam there is a carefully designed surface drainage system. It was obvious that the disintegrated gneiss would erode badly under frequent rains of an intensity of 4 in. per hour, and that the downstream surface would have to be protected. The Government decided to sod it, and a drainage system was therefore necessary. The sod was obtained from the shores of existing tanks (water storage reservoirs, see preceding article by Mr. von der Lippe). These tanks were several miles away, and hauling and placing the sod and getting it to grow proved very expensive. The frequent rains damaged work already in place so that considerable areas had to be done over. It would have been better to protect the downstream face by an adequate layer of crushed rock.

The concrete gravity spillway dam has six 5.75 × 5.75-ft sluice gates, and a free overflow spillway 770 ft long (Fig. 3). For 120 ft of this length, the crest is at El. 260.0, which is the normal full reservoir water surface. For the remaining 650 ft, the crest is at El. 260.25. The slight difference in crest elevation tends to concentrate small overflows where the water can get away best. The maximum flood peak in 14 years of record has been 86,600 cfs. All flood peaks have been very sharp as the floods are of short duration. Assuming a flood with a peak of 150,000 cfs beginning with a full reservoir (water surface at El. 260.0), the water surface would rise to El. 269.0, and at that elevation a maximum of about 86,000 cfs would pass the spillway. The sluice gates are power operated by means of hydraulic cylinders. Two sources of power will be provided, a transmission line from the powerhouse, and a gasoline-engine-driven generator in a chamber in the spillway dam itself.

The earth dikes are small and there is nothing unusual about them.

The water outlet for irrigation and power purposes is near the left abutment of the dam. A trench was dug in solid rock, and in it a welded steel pipe of 13-ft diameter was laid. The pipe was completely surrounded with reinforced concrete, designed to carry the load of the superimposed dam and external water pressure when empty. A reinforced concrete control tower, at the upstream end of this water conduit, houses the control gate and its hoist. Steel trash racks are arranged in an arc around the upstream face. At the downstream end of the water conduit is a surge tank, with a restricted orifice, followed by a steel manifold, from which branch off two pipes for irrigation release and four pipes for the four turbines. Only two of the turbines will be placed initially.

The powerhouse has a concrete substructure, a steel superstructure, and exterior curtain walls of rubble masonry, covered on the outside by stucco and on the inside by plaster. The Ceylonese are excellent masons. It was originally intended that the curtain walls should be brick, but satisfactory brick could not be obtained on the island. Oil and coal must be imported and are therefore expensive, and the local brick is generally underburned.

Each irrigation outlet has a 66-in. Howell-Bunger valve and a 72-in. Dow valve in series. In ordinary operation the Howell-Bunger valve will be used. The Dow valve is upstream and intended only for emergency use.

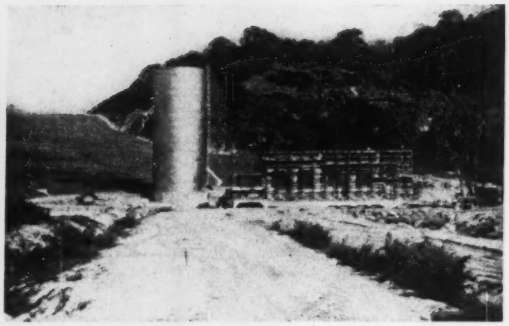
Each generating unit will consist of a Francis-type turbine direct connected to an a-c generator. Turbines are rated as 3,300 hp at an 89-ft head. Generators are 2,750 kva, 0.9 power factor, three phase, 50 cycle. The generating voltage is 6,900.

Water from the turbines, or from the Howell-Bunger valves, will be discharged into a tailbay in which the overburden has been removed to rock. The sides of the tailbay are lined with concrete slabs. From the tailbay a discharge channel leads to a bifurcation structure, which is so arranged and gated that water can be sent down a left-bank canal or a right-bank canal, or wasted to the river between the two canals.

New Town Built in Jungle

At the base of the mountain at the left end of the dam, a new town has been built in the jungle and named Inginiyagala after the mountain. The buildings, generally of masonry, are provided with modern conveniences. Some were built by the government and some by the contractor. Almost all the houses have flowers around them, and banana plants. There are residences for some 20 American families, an office building for the contractor, an office building for the government, barracks and a mess hall for single Americans, a hospital, and barracks and residences for the Ceylonese. Outside the town area proper quite a settlement has sprung up, consisting of

CONCRETE GRAVITY spillway has crest elevation of 260.0 for 120 ft of its length. For remaining 650 ft, crest elevation is 260.25. This difference in height tends to concentrate small overflows where water can get away best.



SURGE TANK at downstream end of water outlet has restricted orifice and is followed by steel manifold with two outlets for irrigation and four for power, although only two turbines are to be installed initially.

native huts and boutiques (the Ceylonese term for a small store, probably dating back to the days of the Portuguese domination).

Many of the Americans have pets, including at least one leopard, monkeys, mouse deer, barking deer, parrots and mynahs. It is a matter of record that one day an American brought in a very pretty little live snake, carefully stowed in a tobacco can in his hip pocket. It turned out to be a Russell's viper, one of the deadliest snakes known.

In 1949 and 1950, the spillway dam was built in the dry. There was no water problem at all. At some time in the geologic past, a large part of the top of Inginiyagala Mountain broke off, and fell down on part of the spillway site. It was necessary to dig through as much as 60 ft of this detritus, mostly very large boulders, to get to a solid rock foundation.

Construction was without particular incident, except for one notable day when a large python decided to take up residence in the conveyor tunnel under the aggregate piles at the crushing plant. Its removal involved some brave advances and precipitous retreats, and there are men who do not like to be reminded of the incident.

In 1949 and 1950, those parts of the main dam on each side of the river channel were built. In April and May 1951, the river was cofferdammed and diverted through the 13-ft-dia conduit previously described. To permit the diverted water to flow freely, the conduit was discontinued just upstream from the surge-tank tee, and an elbow placed to turn the discharge in the desired direction. The gap in the dam at the river channel is now being filled, and when the dam is completed, the control gate at the upper end of the conduit will be closed, the elbow removed, and the conduit connected to the surge-tank tee and through it to the manifolds in the powerhouse. The project has been predominantly an earth-moving job, and therefore in equipping it, earth-moving equipment has been emphasized. Equipment included:

- 2 Marion 2½-cu yd combination shovels and draglines
- 2 Osgood 2½-cu yd combination shovels and draglines
- 1 Bucyrus 2-cu yd shovel
- 1 Bucyrus 1½-cu yd combination shovel, backhoe and dragline
- 1 Bucyrus ¾-cu yd combination shovel, backhoe and dragline
- 2 Lorain truck cranes
- 3 Euclid elevating graders, Model 7 BV
- 30 Euclid 13-cu yd bottom-dump trucks
- 12 Euclid 9-cu yd rear-dump trucks
- 27 Caterpillar D-8 tractors

All equipment is the property of the Ceylon Government, and will pass under its control on completion of the project.

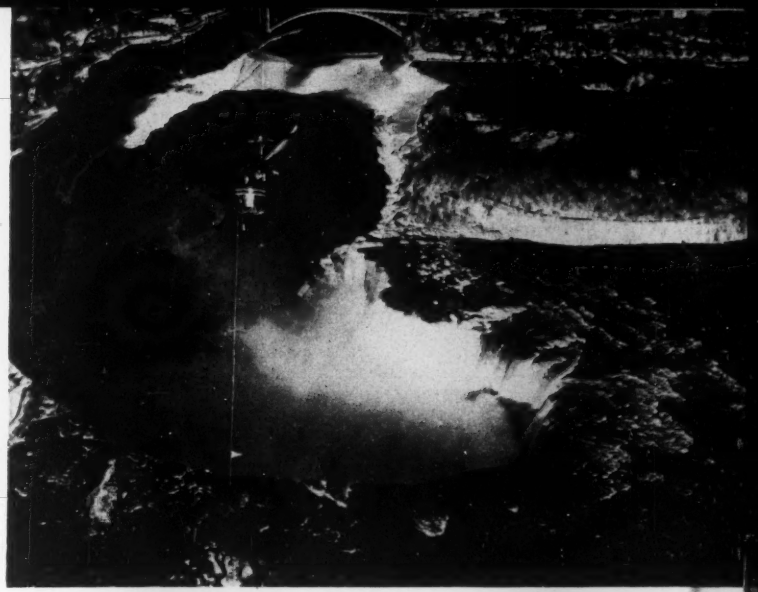
No particular difficulties have been encountered other than those incident to shipment of supplies and equipment halfway round the world. Practically all the tools and equipment used in construction are American made. Since the sources of spare parts in the United States are at least 60 days from the job, a large stock has had to be kept on hand. The disintegrated gneiss has proved abrasive beyond anything in our experience, and crawler-tractor machinery wear has been heavy. We have used about 60,000 lb of welding rod in building up tread systems.

High efficiency and consequently low costs have been attained. A few costs are cited in Table I.

The supreme authority, as far as the contractor is concerned, is Ceylon's Director of Irrigation, W. A. Guthrie. W. T. I. Alagaratnam, Deputy Director, carried out the preliminary investigation for the project. D. W. R. Kahawita is charged with approval of all designs; H. O. T. Scharenguivel is Resident Engineer; J. Canagarathnam is Soils Engineer. A. H. Mendis, who was Deputy Resident Engineer under Mr. Scharenguivel, is now assistant to Jahangir Singh, the engineer in charge of canals.

The staff of Morrison-Knudsen International Co. in Ceylon includes H. B. Olson, Project Manager; George J. Gavin, Chief Engineer; E. M. Bowles, Civil Engineer; Neville G. Adams, Electrical Engineer; Harry Ackerman, Cost Engineer; Lynn Porter, Office Manager; Rex Chaffin, Quarry and Concrete Superintendent; B. H. Pettegrew, Mechanical Superintendent. Moss Hoover, Earthwork Superintendent; and S. D. Waters, Office Engineer, have completed their employment contracts and have already returned home.

Both design and construction are under the general supervision of C. P. Dunn, ASCE, Vice-President and General Manager of Morrison-Knudsen International Co. and President of International Engineering Co. E. F. Koerner is Manager of Construction Operations for M-KI, and E. N. Benson is Business Manager. Messrs. Dunn, Koerner, Benson and the writer have each made several trips to the site.



DIFFICULT problem of taking soundings in Cascades just above Horseshoe Falls in Canadian Channel is solved by use of helicopter, which drops weighted line. Transitmen on shore take readings on target fixed 50 ft above sounding weight. Since helicopter cannot be kept absolutely still, line is run over wheel and counterweighted. Counterweight hangs just below helicopter, at right of sounding line. Since sounding line and target did not show up well on original photo, they have been retouched.

Soundings above Niagara Falls obtained by helicopter and Kytoons

FRANK P. BANE, Major, Corps of Engineers; Executive Officer, Office of District Engineer, Buffalo, N. Y.

ONE of the most novel and difficult assignments in its history was recently completed by the Buffalo District, Corps of Engineers. Under the new Niagara Treaty between the United States and Canada, it became necessary for the District Office to secure accurate under-water contour data on the turbulent Niagara River in the immediate vicinity of Niagara Falls. The natural and technical hazards involved were such as to challenge the imagination and skill of those entrusted with the work.

The treaty between the United States and Canada concerning use of the water of the Niagara River, ratified on October 10, 1950, was designed primarily to enhance the scenic beauty of the world-famous falls, and to prescribe the quantity of water that may be diverted for power by each country.

For years, the beauty of the falls, particularly that of the Canadian Horseshoe Falls, has been impaired by accelerated erosion and by an uneven distribution of the water and concentration of flow near the center of the crest. Any additional diversion for electric power by either government would exaggerate this condition by further reducing the existing sparse flow over the flanks of the falls. Therefore the treaty provided, among other things, for the correction of this situation. The treaty calls for the construction of remedial works designed to distribute the water over the falls in an unbroken crestline, reducing the concentrated flow at the crest. It also states that the work shall be done on an appropriate basis by agencies of both countries, under the supervision of the International Joint Commission. The Corps of Engineers, U.S. Army, was assigned the job for the United States.

Contours Needed for Model Study

Good engineering required the construction of an exact replica of the Niagara River from Lake Erie to the Rainbow Bridge below the falls. Before the model could be constructed—by the Waterways Experiment Station at Vicksburg, Miss.—it was necessary for the Buffalo District, in conjunction with the U.S. Lake Survey, to collect and compile the necessary topographic and hydrologic data. The model will be utilized for the design and verification of the remedial works which must be installed in the prototype, in order to achieve the scenic aspects enjoined by the treaty.

Most of the data required for the model were already available in the

HELICOPTER has sounding apparatus attached on right side near front, within easy reach of co-pilot. Apparatus (see insert) consists of 1,500 ft of 0.026-in. steel music wire wound on nearly frictionless aluminum reel. Counterweight weighs 8 lb and discus-shaped lead sounding weight weighs about 12 lb.

SOUNDINGS in American Channel are taken with three Kytoons bridled together, instead of by helicopter, for reasons of safety. In this channel small islands covered with trees caused breakage of helicopter's sounding line, with consequent falling of counterweight, endangering sightseers. Sounding line for Kytoons was controlled by operator on shore instead of by counterweight.

files of the Buffalo District, having been compiled over the past 50 years in connection with its regular river and harbor duties. For such material, only verification by occasional spot checking was required to insure that the regimen of the river had not materially changed since the data were compiled.

One comparatively small part of the river had, however, always resisted attempts to secure any reliable information on its underwater configuration. This area, which extends from the crest of the falls upstream 1,300 yd to the eastern tip of Goat Island, is known as the Upper Rapids, or the Cascades. Such information as had been compiled on this section was meager and unreliable, since the extreme turbulence and current velocity had precluded the use of sonic devices and other conventional sounding methods. However, the procurement of reliable information on this section was of paramount importance for the model study, since it is here that the remedial works must be constructed.

Helicopter Solves Problem

Suggestions for securing the needed data were solicited from educational institutions, research and development laboratories, surveying firms, and other appropriate sources. However, every scheme submitted proved either impracticable or prohibitive in cost. Actually needed was the proverbial and heretofore mythical sky hook—which eventually materialized in the form of a Bell 47D helicopter located at the Bell Aircraft plant, only $7\frac{1}{2}$ miles from the falls.

It was reasoned that the helicopter while hovering over the Cascades, could lower a weighted line with a target fixed at a known position on the line. Readings on this target could be taken from several instruments located at predetermined stations on shore. By reading both horizontal and vertical angles, the exact location and elevation of the bottom at the point of sounding could then be computed by trigonometric means. During the period of experimentation, however, it was learned that safety precautions required the helicopter to maintain an altitude of more than 1,000 ft while hovering over the falls. At this altitude, because of the remoteness of any fixed object, it proved impossible to maintain the helicopter in a position steady enough to allow definite readings to be taken by transitmen on the ground.

To solve this problem, the sounding line was run over a pulley attached to the helicopter, with a counterweight affixed to the free end of the line. Thus the counterweight kept the sounding line taut at all times, and also compensated for the minor variations in altitude experienced while maintaining the helicopter in a hovering position.

Actual sounding operations above the Horseshoe Falls were initiated on December 7, 1950. Two transits were stationed on each side of the channel at points from which the entire area to be sounded could be observed. Fifteen hundred feet of 0.026-in. steel music wire were wound on a nearly frictionless aluminum reel having an outside diameter of 7 in. To the free end of the wire was attached a discus-shaped lead weight of approximately 12 lb. This apparatus was then bolted to a bracket previously fabricated on the right side of the helicopter at a location within easy reach of the co-pilot.

On completion of all preliminary work, the helicopter was flown to a predetermined position over the Cascades and caused to hover at a height of approximately 1,600 ft. At this point, the co-pilot began lowering the sounding weight by releasing the brake affixed to the reel. At a point in the line exactly 50 ft from the 12-lb sounding weight, a target was attached to a ring which had previously been installed in the sounding line. The target consisted of a wind sock, 1 ft in diameter and 2 ft long, which had

BEAUTY OF NIAGARA—both Canadian Horseshoe Falls at right, and American Falls at left—is to be preserved and enhanced by terms of treaty between United States and Canada, ratified October 10, 1950. Studies for remedial works are now under way on model at Waterways Experiment Station, Vicksburg, Miss. It was to secure accurate data for this model that soundings here described were carried out by Buffalo District, Corps of Engineers.

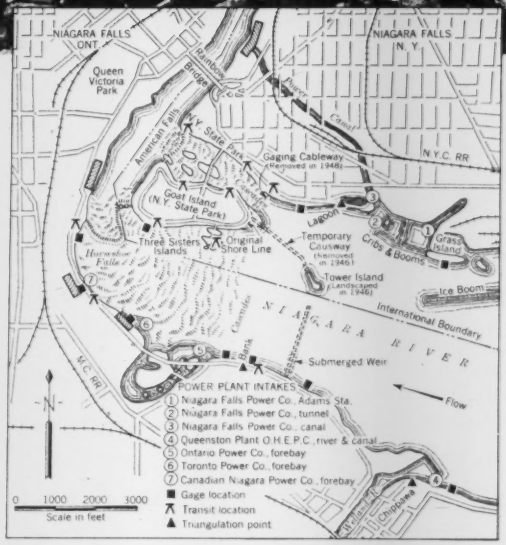


FIG. 1. UP-TO-DATE river-bottom contours both above and below Niagara Falls were required for construction of model at Waterways Experiment Station, Vicksburg, Miss., where studies are under way to find most effective way to preserve beauty of falls despite withdrawals of water for hydroelectric purposes. Cascades area in both Canadian and American Channels had never before been accurately contoured.

been fabricated from orange cambric cloth. After unreeling the entire 1,500 ft of wire, the 8-lb lead counterweight was attached to the end and the wire suspended over the reel in a 0.040-in. groove, which had been machined into the circumference of the reel so that the reel could also serve as a pulley. The helicopter was then lowered until the sounding weight rested on the bottom and the counterweight began to descend. At this instant a signal was transmitted to all transit positions over an air-to-ground, and ground-to-ground radio network. The target was maintained in position for approximately 15 sec to allow the instrumentmen to read and record both horizontal and vertical readings. The helicopter was then elevated until the sounding weight was clear of the water, after which it was moved a horizontal distance of approximately 300 ft. At this point the weight was again lowered into the water and readings taken. The procedure was repeated either until the sounding weight became snagged, or until the extreme cold and fatigue caused the pilot to suspend operations.

Soundings in the Canadian Channel were completed on December 27, 1950, after 252 readings had been obtained. Although 21 days had expired since the project was undertaken, only 21 flying hours were actually expended. The remaining time was charged to bad weather and adverse flying conditions.

Kytoons Used in U.S. Channel

It was originally contemplated that these sounding methods could be utilized in the entire Cascades section, but safety considerations were found to preclude their use in the American Channel. Here numerous small islands covered with trees and brush caused frequent snagging and consequent breakage of the sounding line. As a result, the counterweight was free to plummet to the earth from an altitude of 1,500 feet, endangering pedestrians and vehicles passing over Goat Island Bridge and in the park areas adjacent to the channel. Then too, there was no clear area in the immediate vicinity to which the helicopter could glide in the event of an emergency.

For these reasons an alternate method was devised for use in the American Channel. The helicopter was replaced by three dirigible-shaped, helium-filled balloons called Kytoons. Bridled together as shown in the photograph, the Kytoons were controlled by a 125-lb test nylon cord and maintained a comparatively stable position in wind velocities up to 20 miles per hour on account of their aerodynamic design. Experimentation proved that a combination of one 82-cu ft and two 48-cu ft Kytoons afforded the lifting power required for operation in the wind velocities encountered at the site, which were generally from 5 to 15 miles per hour.

As in the case of the helicopter, a small pulley was attached to the balloons, and through it the sounding line was threaded. A 5-lb sounding weight was attached to one end and a target fixed on the line exactly 20 ft above the weight. In this case, however, the sounding weight was controlled by an operator stationed on shore, rather than by a counterweight.

Sounding operations in the American Channel were initiated on January 3, 1951. Depending on the wind direction, the Kytoons supporting the sounding weight were launched from either Goat Island or the United States mainland and flown to a position in the channel where soundings were desired. The sounding line was then paid out by the operator on shore until the weight rested on the bottom. At this instant, the transit parties were directed by radio to secure the necessary readings. On completion of a reading, the weight was elevated above the water surface, the Kytoons maneuvered to another position, and the operation repeated until a total of 500 readings were obtained.

When the survey of the Upper Rapids was completed by the methods outlined, sounding operations were continued in the gorge below the falls by more or less conventional methods. It is interesting to note that soundings of 168 ft have been recorded in the vicinity of the Rainbow Bridge, representing a depth of water approximately equal to the height of the falls.

In carrying this difficult survey to completion, Bell Aircraft experts joined with the Army Engineers under the traditional motto of the Corps, *Essayons*, or "Let us try." The accurate data obtained by these ingenious methods will add to the value of the design and model tests necessary in the Niagara studies.

VEN TE CHOW, Assoc. M. ASCE

Department of Civil Engineering, University of Illinois, Urbana, Ill.

Hydrodynamic pressure due

IN THE DESIGN of certain hydraulic structures such as dams, sea walls, and levees, which are located in earthquate regions and exposed to water with a free surface on a wide frontal area, the hydrodynamic pressure on the structure due to earthquake action has been receiving much attention from designing engineers. Indeed, many engineering specifications require that this hydrodynamic pressure be accurately evaluated and that provisions be made in the design against earthquake shock.

Computation of the hydrodynamic effect due to a vertical earthquake shock is a simple problem in present designing practice, assuming a proportional increase or decrease in weight of water equal to the ratio between maximum vertical earthquake acceleration and acceleration due to gravity for an upward, or a downward, shock. The design value of this ratio is generally taken as 0.1.

Computation of hydrodynamic pressure due to a horizontal earthquake shock is much more difficult because of the complicated mathematics involved. Prof. H. M. Westergaard, M. ASCE, has made a theoretical study of this subject in his paper, "Water Pressure on Dams During Earthquakes," (ASCE TRANSACTIONS, Vol. 98, 1933, pp. 418–472). Based on his work, the hydrodynamic pressure, in pounds per square foot, at a point perpendicular to the face of a structure exposed to water, due to a horizontal earthquake acceleration, may be computed by the formula,

$$P = \alpha\beta\gamma h^{1/2}$$

in which

h = vertical depth of point below water surface, in feet.

α = ratio of maximum horizontal earthquate acceleration to acceleration due to gravity, 32.2 ft per sec^2. This ratio is generally taken as 0.1 in designing practice.

β = factor depending on: (1) the slope, $1/s$, of the line joining the intersecting point of the water surface and the face of the structure to the point in question; and (2) the period of horizontal earthquake vibra-

Dominant Role Urged for "Unity Organization"

TO THE EDITOR: Because of the current interest in unity, as a result of the EJC proposal of four possible plans, I am taking the liberty of expressing some thoughts that may be of use to other members of our Society.

The objection some of us have to all of the four plans is that none of them seem to be appropriate to really unify the profession to give it the power of which it is capable. Whether we like it or not, today it seems to be necessary to have power through numbers to gain adequate national recognition of our needs.

I believe we could gain the same strength as the powerful American Medical Association has if we would form an organization that would include all qualified engineers. If we don't, we still will not gain the economic and professional levels of which we are capable. Any unity organization that restricts membership only to members of existing technical or professional societies will fall short of real unity, in my opinion.

It is felt also by many of us that besides being open to all qualified engineers, the unity organization should also be managed by them through individual voting, rather than controlled through the technical societies. We feel there is in the plans proposed too much of an attempt to preserve existing power within presently autonomous organizations and a lack of recognition of the primary need for one all-powerful group to represent the pro-

to horizontal earthquake shock computed by curves

tion. As the design vibration period is usually taken as 1 sec, the corresponding relation between this factor and the slope, $1/s$, has been computed and is shown on the chart, Fig. 1. If the structure has a vertical face, $1/s = \infty$, and $\beta = 1$.

γ = factor depending on the total depth of water, H, from the bottom of the structure and the period of horizontal earthquake vibration. For a design vibration period of 1 sec, the relation between this factor and the total depth of water, in feet, has been computed and is shown in Fig. 1.

After the pressure distribution along the face of the structure exposed to water is computed, the total pressure and its point of application can be found by graphic statics or by using a mechanical integrator.

Example: Given, $\alpha = 0.1$, $H = 200$ ft, $1/s = 1/0.08$ or 12.5, and $h = 160$ ft. From the curves, $\beta = 0.9$ and $\gamma = 730$. Then $P = (0.1)(0.9)(730)(160)^{1/2} = 831$ psf.

These curves are reproduced with modification from an unpublished manuscript on "Analysis of Stresses in Gravity Dams," prepared by the writer, and he is greatly indebted to Prof. W. C. Huntington, M. ASCE, head of the Civil Engineering Department, University of Illinois, for his kindness in directing the work.

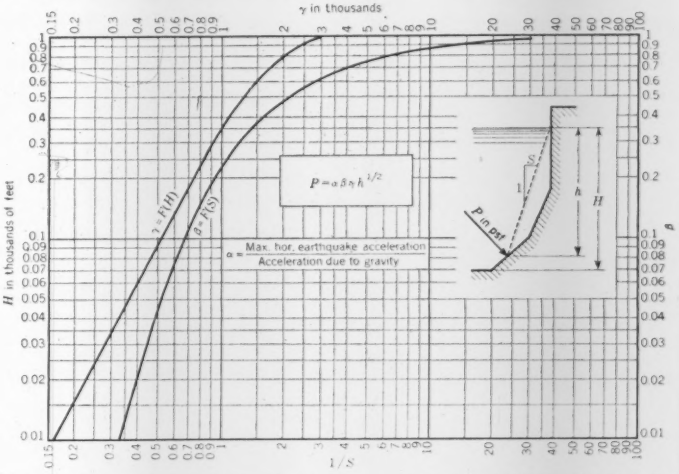


FIG. 1. CURVES give hydrodynamic pressure on a structure due to horizontal earthquake shock, for design vibration period of 1 sec.

fession. If gaining real unity in the profession means shifting the technical societies to a relatively subordinate position, many of us who are loyal and devoted technical society members can see no harm done. The technical worth of these societies would not be diminished at all. It is understood the medical profession operates in such a fashion, and we have a long way to go to equal it.

It will probably be of interest to other Local Sections to know that the Colorado Section submitted to the Board its beliefs in five paragraphs, briefed as follows (the full text will be supplied gladly by the writer on request):

1. That Plan "C" as recommended by the exploratory group, is the most practicable of the four plans recommended, but there should be a major change in the relationship of the technical societies to the organization. These societies should be related to the Unity Organization through their members as "individual members."

2. That the Unity Organization should be the principal group supported by the nation's engineers.

3. That all engineers who are qualified to register under the "model law" be acceptable for membership in the Unity Organization. Further, that membership be not contingent upon membership in one of the technical societies.

4. That the Unity Organization be supported by annual dues in an amount approximating that now paid for membership in one of the technical societies by those not affiliated with technical groups, and by a small additional fee (not more that $5) to be paid by members of technical societies.

5. That the management of the Unity Organization shall be elected by the membership of the Unity Organization.

If unity is not achieved now while it seems most propitious, then many engineers will probably find the rapidly spreading engineering collective bargaining groups all they need for economic improvement.

T. H. EVANS, M. ASCE
Dean, Colorado A. & M. College
Fort Collins, Colo.

Six Companies Inc., Hoover Dam Contractors, Actually Consisted of Eight Companies

TO THE EDITOR: In Mr. Tripp's article, "Joint-Venture Contracting—Phenomenon of the Construction Industry" (June 1951 issue, p. 30) a photograph of Hoover Dam bears a caption listing the joint venturers in the Six Companies Inc., as Utah Construction Co. (sponsor), Pacific Bridge Co., Kaiser Paving Co., Ltd., MacDonald & Kahn Co., Morrison-Knudsen Co., and J. F. Shea Co. This statement is incorrect. For the record, it should be noted that the stockholders of Six Companies Inc., the contractors for Hoover Dam, consisted of:

Utah Construction Co.
Pacific Bridge Co.
MacDonald & Kahn Co.
Morrison-Knudsen Co.
J. F. Shea Co.
Bechtel-Kaiser-Warren Co.

For the purpose of associating together on the Hoover Dam contract, W. A. Bechtel Co. of San Francisco, Kaiser Paving Co. of Oakland, and Warren Brothers Co. of Boston, formed Bechtel-Kaiser-Warren Co., so that actually there were eight companies participating in the construction of Hoover Dam. However, corporately, as you will note, the combination of three of them permitted the use of the name Six Companies Inc.

One other thing of interest is the fact that through an error of the attorneys in incorporating the company, the conventional proper punctuation which uses the comma after "companies" was omitted in the telegram, and the company was actually incorporated as Six Companies Inc., without the comma, and it has always maintained that corporate name since then.

W. E. WASTE, *Vice President*
Bechtel Corporation
San Francisco, Calif.

Second Coulee Dam Contract Sponsored by Henry J. Kaiser Co.

TO THE EDITOR: I write to call your attention to two slight errors in your June issue.

The first occurs on page 31. The caption under the picture of Grand Coulee Dam states that Silas Mason Co. was the sponsor of the second contract for that dam, let in January 1938. As a matter of fact, this company was the sponsor of the first contract covering the foundations of the dam and the diversion of the river, let in 1934 to the Silas Mason Co., Walsh Construction Co. and Atkinson-Kier Co. The second contract, let in 1938 to Mason-Walsh-Atkinson-Kier and the Kaiser group, was sponsored by the Henry J. Kaiser Co.

The second error occurs on page 34, in the superimposed labels on the photograph on the left side of the page showing construction under way on Grand Coulee Dam. The label "Coulee City" in the background should read "Mason City." Coulee City is at the other end of the Grand Coulee Reservoir some 35 miles away.

FRANCIS DONALDSON
Silas Mason Co., Inc.
New York, N.Y.

Limitations of Theoretical Non-Gravity Buttress-Type Dam Discussed

TO THE EDITOR: The article, "Buttress-Type Dam with Curved Upstream Face Proposed," by Horace P. Boardman in the June issue, describes an interesting theoretical design of a non-gravity-type dam.

The writer, while an employee of the Harza Engineering Co. in 1929, used the same general principle on the design of a 10-ft flashboard to overturn at given depths of water over the crest of a dam. The theory of balancing forces was used by utilizing the weight of the water to resist overturning. See Fig. 1. The fulcrum was placed at one-third the desired head and the weight of the vertical portion of the structure was arranged to pass through this pivotal point.

There are several undesirable features in the type of dam proposed. In the first place construction joints probably would limit the height of the structure. In locations on limestone or other cavernous rock, where foundation leakage might be anticipated, no type of dam with a sloping upstream face should be considered because if leakage develops in a foundation after the reservoir has been filled, there is no way to get at the cutoff for subsequent foundation treatment. This is particularly true of higher structures.

The writer has had experience on foundation-leakage corrective work on both gravity and earth and rock-fill dams. Unless a structure is so constituted that corrective treatment can be applied directly through the structure at the cutoff, it becomes a very expensive and troublesome procedure and one for which about the only solution is to drain the reservoir for major repairs.

For example, on a dam 300 ft high with an average 1:1 upstream slope, the point of application for foundation treatment at the cutoff would be 425 ft away from any possible starting point on the dam. The spacing of grout holes would be very difficult and inaccurate at this distance. Similarly, location of the cutoff from the water surface is almost impossible. Also, treatment from downstream might be hazardous.

Contrariwise, treatment applied by drilling vertically through a gravity dam into the foundation is practical and expedient. From experience this approach has been successful. Water from pressure exerted through water-bearing cavities can do no harm in finding its level in such vertical holes. A similar condition in a downstream hole of a hollow-type structure could be very troublesome.

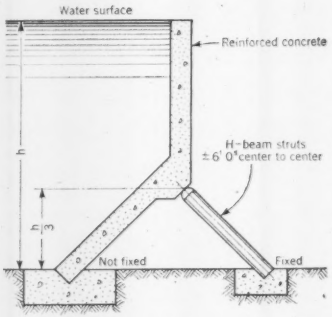


FIG. 1. Flashboard 10 ft high was designed to overturn at given depths of water over crest of dam.

For these reasons the type of dam suggested by Mr. Boardman has some definite limitations other than those of thin sections and costly formwork.

LEWIS A. SCHMIDT, JR., M. ASCE
Schmidt Engineering Co.
Chattanooga, Tenn.

AMERICAN SOCIETY OF CIVIL ENGINEERS

1951 ANNUAL CONVENTION

NEW YORK, N.Y., STATLER HOTEL, OCTOBER 22–26, 1951

Registration: Convention Rotunda, Statler Hotel, opens 9:00 a.m., Monday, October 22, each convention day 9:00 a.m. to 5:00 p.m.

NOTE: Registration will be closed from 10:30 to 11:00 a.m. on Wednesday, October 24, to avoid conflict with opening of the Annual Business Meeting. Registration fee (except ladies and students) $2.00.

Authors' Breakfasts

PARLOR 2 STATLER HOTEL

Monday, October 22, 8:15 a.m.
Tuesday, October 23, 8:15 a.m.
Thursday, October 25, 8:15 a.m.
Friday, October 26, 8:15 a.m.

Briefing sessions for all speakers, discussers and program officials by invitation. *Presiding*: WILLIAM S. LA LONDE, JR., Convention Chairman.

Monday Events, October 22

Morning Division Sessions

Power Division

9:30 A.M. KEYSTONE ROOM

Presiding: James P. Growdon, Chairman, Executive Committee, Power Division

9:30 **Unusual Features of Design of South Holston Power Project**

OLAV LAVIK, M. ASCE; Design Engineer, Tennessee Valley Authority, Knoxville, Tenn.

10:30 **Delaware River Aqueduct Hydro Projects**

GEORGE RICH, M. ASCE; Charles T. Main, Inc., Boston, Mass.

Surveying and Mapping—Air Transport, Joint Session

9:30 A.M. PENN TOP

Presiding: S. A. Bauer, Chairman, Executive Committee, Surveying and Mapping Division

H. H. Howell, Chairman, Executive Committee, Air Transport Division

9:30 **Zoning For and Around Airports**

B. EVERETT BEAVIN, SR., M. ASCE; Consulting Engineer, Linthicum Hts., Md.

Discussion

CHARLES A. BLESSING, M. ASCE; Director of Planning, Chicago Plan Commission, Chicago, Ill.

10:15 **Aeronautical Charting and Mapping**

CHARLES A. SCHANCK, Assoc. M. ASCE; Commander, USN, U. S. Coast and Geodetic Survey, Washington, D.C.

Discussion

E. S. FABIAN, Assoc. M. ASCE; Professor of Civil Engineering, University of Tennessee, Knoxville, Tenn.

11:00 **Electronic Devices in Air Transport**

F. B. LEE, Deputy Administrator, Civil Aeronautics Administration, Washington, D.C.

Discussion

P. C. SANDRETTO, Assistant Technical Director, Federal Telecommunication Laboratories, Inc., Nutley, N.J.

Hydraulics Division

Joint Committee on Snow, Ice and Permafrost

9:30 A.M. SKY TOP

Presiding: George R. Schneider, Chairman, Executive Committee, Hydraulics Division

9:30 **The Mission of Snow, Ice and Permafrost Research Establishment**

A. H. LAHLUM, Lt. Col., U. S. Army, Commanding Officer, S.I.P.R.E.

10:15 **Cold Weather Engineering Problems**

P. W. ROBERTS, M. ASCE; Commander, U. S. Navy, Bureau of Yards and Docks.

11:00 **Operation of Swiss Institute for Snow and Avalanche Research**

A motion picture prepared by the Swiss Institute, presented with comments by Henri Bader, formerly Director of the Institute.

Waterways Division

9:30 A.M. BALLROOM

Presiding: Max C. Tyler, Chairman, Executive Committee, Waterways Division

9:30 **Marine Borer Research**

GEORGE KNOX, Bureau of Yards and Docks, U. S. Navy, Washington, D.C.

10:00 **Construction of Lock No. 2, Monongahela River**

E. P. SWATEK, Chief Design Engineer, Contracting Division, Dravo Corp., Pittsburgh, Pa.

10:30 Surveys of Rivers in Unmapped Territory

GERARD H. MATTHES, Hon. M. ASCE; Consultant, New York, N.Y.

11:00 Timberhead—a motion picture

Pictures river transportation in the mid-continent area, and benefits to commerce and industry. A presentation of the Union Barge Co., Pittsburgh, Pa.

Power Luncheon

MONDAY, OCTOBER 22, 12:30 P.M.
GEORGIAN ROOM

Sponsored by the Power Division
Price per plate: $3.50

Board–Local Section Luncheon

MONDAY, OCTOBER 22, 12:30 P.M.
PENN TOP NORTH

A "get-acquainted" event for members of the ASCE Board of Direction and delegates attending the Local Section Conference. Per plate: $3.50.

Afternoon Division Sessions

Hydraulics Division

Joint Committee on Snow, Ice, and Permafrost

Subcommittee on Snow

2:30 P.M. **SKY TOP**

Presiding: George R. Schneider, Chairman, Executive Committee, Hydraulics Division

2:30 Snow Thermodynamics: An Approach to a Better Understanding of the Mechanical Properties of Snow

R. W. GERDEL, Assoc. M. ASCE; Chief, Field Operations Section, Snow, Ice and Permafrost Research Establishment

3:15 Evaporative Losses from Snow

WALTER T. WILSON, Assoc. M. ASCE; U. S. Weather Bureau, Cooperative Snow Investigations, San Francisco, Calif.

4:00 Application of Snow Hydrology in the Planning and Design of Multi-Purpose Reservoirs

HERBERT S. RIESBOL, M. ASCE; Project Planning Branch, Bureau of Reclamation, Denver, Colo.

Power Division

2:30 P.M. **KEYSTONE**

Presiding: James P. Growdon, Chairman, Executive Committee, Power Division

2:30 Growth in Concrete

STANLEY MOYER, M. ASCE; Mechanical Engineer, Philadelphia Electric Co.

3:30 American Participation in the Development of Far Eastern Countries—Psychological, Economic and Engineering Aspects

A. V. KARPOV, M. ASCE; Consulting Engineer, New York, N.Y.

Sanitary Engineering Division

2:30 P.M. **PENN TOP**

Presiding: Alfred H. Wieters, Chairman, Executive Committee, Sanitary Engineering Division

National Water Resources—A Panel Discussion

2:30 The Viewpoint of the Engineers Joint Council

W. W. HORNER, Past President, ASCE; Consulting Engineer, St. Louis, Mo.

3:00 The Viewpoint of the President's Water Policy Commission

SAMUEL B. MORRIS, M. ASCE; General Manager and Chief Engineer, Los Angeles Department of Water and Power, Los Angeles, Calif.

3:30 Discussion

3:45 Some Practical and Economic Effects of Rainfall Stimulation on Water Resources

WALLACE E. HOWELL, Consulting Meteorologist

4:15 Discussion

4:30 Report of Committee on Water Supply Engineering

ERNEST W. WHITLOCK, M. ASCE; Engineer, Malcolm Pirnie, New York, N.Y.

Report of Committee on Infiltration and Loss in Sewage Collection Systems

GEORGE R. THOMPSON, City Engineer, City Hall, Detroit, Mich.

Waterways Division Tour

Unusual structural boxes to support the new 57th Street shipping pier will be visited on Monday afternoon, October 22. These huge reinforced concrete boxes are being constructed in a cofferdam at Haverstraw, New York, some 35 miles up the Hudson River from their final place under the pier at West 15th Street, in Manhattan. Construction will be in progress during the inspection.

Details of time and transportation will be given in later programs.

Card Party for the Ladies

MONDAY AFTERNOON
PARLORS B AND C

An informal gathering of the ladies attending the Convention, to plan activities for the week, make new acquaintances and greet old friends.

Cooperative Session

U. S. Council of the International Association for Bridge and Structural Engineering

Tuesday, October 23—2:00 p.m.
PARLOR NO. 2 **HOTEL STATLER**

Consultants' Dinner

Monday, October 22

6:30 P.M., KEYSTONE ROOM
STATLER HOTEL

Annual Dinner of the American Institute of Consulting Engineers.

Local Sections Conference

9:30 A.M. MONDAY AND TUESDAY
OCTOBER 22 AND 23

PARLOR 1 **STATLER HOTEL**

Representatives of Local Sections of ASCE in the Northeast area will convene upon invitation for discussion of operations of the Sections.

The conference, which is primarily for appointed delegates of selected Sections, will be open to any and all who may be interested especially in activities of ASCE at Local Section level.

Tuesday Events, October 23

Ladies' Breakfast

Tuesday, October 23
9:15 A.M. ALTMAN'S

B. Altman & Co., Fifth Avenue at 34th Street, is holding a breakfast for the wives and guests of members in the famous Charleston Gardens. A special program will be presented for the ladies followed by a personally conducted tour of the outstanding features of the store. Unusual displays include the Beacon Hill Gallery, which has twelve superbly decorated rooms and prize collections that will delight the heart of any shopper. Personal shoppers will assist any who wish such service.

Price $.75 per person.

Morning Division Sessions

Engineering Mechanics Division, Inaugural Session

9:30 A.M. BALLROOM

Presiding: L. E. Grinter, Chairman, Executive Committee, Engineering Mechanics Division

9:30 Dedication of Division

Speaking for the field of Solid Mechanics

J. N. Goodier, Professor of Theoretical and Applied Mechanics, Stanford University, Palo Alto, Calif.

Speaking for the field of Fluid Mechanics

Hugh L. Dryden, Director of Aeronautical Research, National Advisory Committee for Aeronautics, Washington, D.C.

Technical Papers—
Clayton O. Dohrenwend, Secretary of Division, Presiding

10:30 A Theoretical and Experimental Investigation of Radial Impact on an Elastically Supported Ring

Edward Wenk, Navy Department, Washington, D.C.

11:00 Graphical Solution of First-Order Differential Equation with Applications to Hydraulics

Kenneth E. Sorensen, Jun. M. ASCE; Harza Engineering Co., Chicago, Ill.

11:30 Discussion

Hydraulics Division,

Joint Committee on Snow, Ice, and Permafrost

Subcommittee on Ice

9:30 A.M. SKY TOP

Presiding: George R. Schneider, Chairman, Executive Committee, Hydraulics Division

9:30 Investigations on Ice

E. W. Johnson, Bureau of Yards and Docks, U. S. Navy

10:00 Strength and Use of Fresh and Salt Water Ice

Kenneth A. Linell, Assoc. M. ASCE; New England Division, U. S. Army, Corps of Engineers, Boston, Mass.

10:30 Development of Air Fields on Ice

Bernt Balchen, Colonel, U. S. Air Force, and John Holmes, Oceanographic Laboratory, Woods Hole, Mass.

11:00 Report on Glacial Ice Investigations

William O. Field, American Geographical Society, New York, N.Y.

11:30 Problems of Icing on Roads and Air Fields

A. F. Ghiglione, M. ASCE; Chairman, Joint Committee on Snow, Ice and Permafrost

Sanitary Engineering Division

9:30 A.M. PENN TOP

Presiding: F. Woodbury Jones, Member, Executive Committee, Sanitary Engineering Division

9:30 What We Need to Know About the Controlled Materials Plan—A Panel Discussion

A M Rawn, M. ASCE; General Manager, Los Angeles County Sanitation Districts, Moderator

Harvey Howe, Director of the Water Resources Division, NPA

Louis R. Howson, Director, ASCE; Consulting Engineer, Chicago, Ill.

Carl Schwob, Chief, Division of Water Pollution Control, U. S. Public Health Service

Milton P. Adams, M. ASCE; Executive Secretary, Michigan Water Resources Committee, Lansing, Mich.

Harry L. Conrad, M. ASCE; President, The Christman Co., Lansing, Mich.

Frank Conover, Procurement Dept., The Dorr Co.

10:30 The Sanitary Engineer vs. the Chemical Engineer: Their Places in Industrial Waste Treatment for the Sanitary Engineer:

Rolf Eliassen, M. ASCE; Professor of Sanitary Engineering, Massachusetts Institute of Technology

11:00 For the Chemical Engineer:
H. L. Jacobs, Head, Industrial Waste Work, Dupont de Nemours

11:30 Discussion

11:45 Report of the Committee on Sanitary Engineering Research

Harry E. Schlenz, Assoc. M. ASCE; Vice-President and Sales Manager, Pacific Flush Tank Co., Chicago, Ill.

Engineering Mechanics Luncheon

Tuesday, October 23
12:30 P.M. GEORGIAN ROOM

Program of the new Engineering Mechanics Division will be inaugurated with a series of sessions, including this luncheon. Program will feature an address by ASCE President Gail A. Hathaway. His subject will be, "The Engineering Mechanics Division's Interest in National and International Affairs."

Price $3.50 per plate.

New York Harbor Tour

Tuesday, October 23

Leaves 42nd Street Pier at 12:30 p.m.

The fascinating installations fringing New York Harbor will be viewed from the decks of the *Niagara* during an afternoon excursion. The Hudson River piers, historic Riverside Drive monuments, expressways, bridges, and all the points of interest in the lower harbor will be included.

The Port of New York Authority and the New York Central System have cooperated in sponsoring this boat trip. A box lunch will be served on board en route.

Price, $1.25, per ticket with everything included.

Afternoon Division Sessions

Engineering Mechanics Division—Inaugural Session

2:30 P.M. BALLROOM

Presiding: Nathan M. Newmark, Member, Executive Committee, Engineering Mechanics Division

2:30 Forced Vibrations of Continuous Beams

E. Saibel and Elio D'Appolonia, Assoc. M. ASCE; Carnegie Institute of Technology, Pittsburgh, Pa.

3:00 **Ground Periods and Amplitudes in Destructive Earthquake Motions**

FRANK NEWMANN, Chief, Seismology Branch, U. S. Coast and Geodetic Survey, Washington, D.C.

3:30 **Analysis of Earthquake Stresses by Natural Modes and Step-by-Step Integration**

MARIO S. SALVADORI, M. ASCE; Columbia University, New York, N.Y.

4:00 **Non-Elastic Behavior of Bridges Under Impulsive Loads**

S. J. FRAENKEL and L. E. GRINTER, M. ASCE; Illinois Inst. of Technology, Chicago, Ill.

Hydraulics Division

Joint Committee on Snow, Ice, and Permafrost

Subcommittee on Permafrost

2:30 P.M. **SKY TOP**

Presiding: George R. Schneider, Chairman, Executive Committee, Hydraulics Division

2:30 **Permafrost Investigations in the United States**

HENRY J. MANGER, U. S. Army, Corps of Engineers, St. Paul District, St. Paul, Minn.

3:00 **Design and Construction in Permafrost Areas**

GEORGE W. RATHJENS, M. ASCE; Consulting Engineer, Berkeley, Calif.

3:30 **Photographic Interpretation of Permafrost Conditions**

ROBERT E. FROST, Assoc. M. ASCE; Research Engineer, Joint Highway Research Project, Purdue University, West Lafayette, Ind.

4:00 **Research Needs for Frost and Permafrost**

C. W. LOVELL, JR., Jun. M. ASCE; Research Engineer and Instructor, Joint Highway Research Project, Purdue University, West Lafayette, Ind.

A. W. JOHNSON, Assoc. M. ASCE; Engineer of Soils & Foundations, Highway Research Board, Washington, D.C.

Sanitary Engineering Division

2:30 P.M. **PENN TOP**

Presiding: B. A. Poole, Member, Executive Committee, Sanitary Engineering Division

2:30 **Financing Sewage Treatment Plants: How to Pay for New Plants Under Today's High Costs**

A PANEL DISCUSSION

E. J. CLEARY, M. ASCE; Executive Director and Chief Engineer, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio—Moderator

SAMUEL A. GREELEY, M. ASCE; Consulting Engineer, Chicago, Ill.

GEORGE J. SCHROEPFER, M. ASCE; Professor of Sanitary Engineering, University of Minnesota; Minneapolis, Minn.

FRANCIS S. FRIEL, M. ASCE; Consulting Engineer, Albright & Friel, Inc., Philadelphia Pa.

GEORGE P. STEINMETZ, M. ASCE; Chief Engineer, Service Commission of Wisconsin, Madison, Wis.

THOMAS M. NILES, M. ASCE; Consulting Engineer, Greely & Hansen, Chicago, Ill.

W. JAMES MCINTOSH, Attorney, Morgan, Lewis & Bockius, Philadelphia, Pa.

4:00 **Report of the Committee on Advancement of Sanitary Engineering**

EARNEST BOYCE, M. ASCE; Professor, Sanitary Engineering, Dept. of Civil Engineering, University of Michigan, Ann Arbor, Mich.

Report on Sewage Treatment of Committee on Sewerage

LANGDON PEARSE, M. ASCE; Sanitary Engineer, Chicago, Ill.

Wednesday Events, October 24

Ninety-Ninth Annual Business Meeting

10:30 A.M. **GEORGIAN ROOM**

Presiding: Gail A. Hathaway, President, American Society of Civil Engineers

10:30 **Annual Reports of Board of Direction, Secretary and Treasurer**

Announcements and Reports

10:45 **Presentation of Awards**

The Norman Medal to David B. Steinman, M. ASCE.

The J. James R. Croes Medal to M. E. Von Seggern, Assoc. M. ASCE

The Thomas Fitch Rowland Prize to William K. Boyd, M. ASCE, and Charles R. Foster, Assoc. M. ASCE

The James Laurie Prize to Hans H. Bleich, M. ASCE.

The Arthur M. Wellington Prize to A. Hrennikoff, M. ASCE.

The Collingwood Prize for Juniors to John W. Forster, Jun. M. ASCE, and Raymond A. Skrinde, Jun. M. ASCE.

The J. C.-Stevens Award to James S. Holdhusen, Jun. M. ASCE.

The Karl Emil Hilgard Prize to M. L. Albertson, Jun. M. ASCE, and Y. B. Dai, R. A. Jensen, and Hunter Rouse, M. ASCE.

The Leon S. Moisseiff Award to Ling-Hi Tsien.

The Construction Engineering Prize to James G. Tripp, M. ASCE.

11:15 **Report of Tellers on Canvass of Ballot for Officers**

Installation of New Officers

Director, District 1—Walter D. Binger
Director, District 2—Frank A. Marston
Director, District 6—George W. McAlpin
Director, District 10—James A. Higgs
Director, District 11—I. C. Steele
Vice President, Zone 1—George W. Burpee
Vice President, Zone IV—A M Rawn
President—Carlton S. Proctor

11:30 **New Business**

Adjournment for Membership Luncheon.

Annual Membership Luncheon

Wednesday, October 24

12:30 P.M. **BALLROOM**

Toastmaster for the occasion: William S. La Londe, Jr., Chairman of the Annual Convention Committee.

All members, their ladies, guests and friends of ASCE are cordially invited to attend this luncheon and enjoy the opportunity of sharing a stimulating address.

Price $3.50 per plate.

Student Chapter Faculty Advisers Conference

Wednesday, October 24

2:30 P.M. **PARLOR 2**

Presiding: Robert H. Dodds, Member, Committee on Student Chapters

All Student Chapter Faculty Advisers and Contact Members in attendance at the Annual Convention are invited to take part in this round-table discussion of student affairs.

General Session Civil-Military Liaison

WEDNESDAY AFTERNOON

2:30 P.M. GEORGIAN ROOM

Presiding: Ernest E. Howard, Past President ASCE, Chairman, Committee on Civil-Military Liaison

Modern Concepts of Military Engineering

LEWIS A. PICK, M. ASCE; Lt. General, U.S. Army, Chief of Engineers, Washington, D.C.

Engineering Problems of the Air Force

COLBY M. MYERS, Assoc. M. ASCE; Brigadier General, U.S. Air Force, Staff Engineer, Strategic Air Command, Washington, D.C.

Civil Engineering in the Navy

JOSEPH F. JELLEY, JR., M. ASCE; Rear Admiral CEC, U.S. Navy, Chief, Bureau of Yards and Docks, Washington, D.C.

The Role of the Civilian Engineer in the Defense Mobilization Program

CARLTON S. PROCTOR, President-Elect, ASCE; Consulting Engineer, New York, N.Y.

Annual Dinner and Dance

President's Reception and Award of Honorary Memberships

WEDNESDAY EVENING
STATLER BALLROOM

6:30 **Assembly and Cocktails, Rotunda**

7:45 **Dinner, Ballroom**

9:00 **Awards and Presentation of the White House Gavel**

9:30 **President's reception and dancing**

Dinner Music **Dance Music**
Entertainment

For this event, special arrangements can be made for reservation of tables seating 10 persons.

Members may underwrite complete tables, or pool reservations with others. Orders for tables must be accompanied by a check in full and a list of guests.

The published seating list will close at 5:00 p.m., Tuesday, October 23. Tickets purchased after this hour will be assigned to tables in order of purchase. Sales of tickets will be limited to capacity of the Ballroom.

Per plate $10.00 Dress formal.

Thursday Events, October 25

Morning Division Sessions

City Planning Division

9:30 A.M. PENN TOP

Presiding: Leslie Williams, Member, Executive Committee, City Planning Division

9:30 **Vertical vs. Horizontal Urban Development**

C. MCKIM NORTON, Executive Vice-President, New York Regional Plan Association

10:00 **Lessons Learned from Recent Experiences with Large-Scale Housing Developments**

WILLIAM C. VLADICK, Architect, New York, N. Y.

10:30 **Integration of Railroads and Rapid Transit Facilities in New York Area**

WILLIAM REID, President, Hudson & Manhattan Railroad, New York, N.Y.

11:00 **Planning Program for New York City**

EUGENE M. ITJEN, M. ASCE; Chief, Office of Master Plan Department of Planning, City of New York, N.Y.

Hydraulics Division

Subcommittee on Hydraulic Research

9:30 A.M. SKY TOP

Presiding: George R. Schneider, Chairman, Executive Committee, Hydraulics Division

9:30 **Turbulence Studies from Recordings of Instantaneous Pilot Tube Pressures**

ARTHUR T. IPPEN, M. ASCE; Professor of Hydraulics, Massachusetts Inst. of Technology and EMMERT M. LOWRY, JR., Jun. M. ASCE; Hydraulic Engineer, S. Morgan Smith Co.

10:15 **Measurement of Velocity and Pressure in Turbulent Flow**

PHILIP G. HUBBARD, Research Engineer, Iowa Institute of Hydraulic Research, State University of Iowa

11:00 **Velocity Measurement of Air-Water Mixtures**

LORENZ G. STRAUB, M. ASCE, JOHN KILLEEN, OWEN P. LAMB, St. Anthony Falls Hydraulic Laboratory, University of Minnesota

Soil Mechanics and Foundations Division

Sponsored Jointly by the Department of Soils Investigation, Highway Research Board, and the U. S. National Council on Soil Mechanics and Foundation Engineering

9:30 A.M. KEYSTONE ROOM

Presiding: Carlton S. Proctor, President, ASCE

9:30 **Introductory remarks**

PHILIP C. RUTLEDGE, Chairman, Executive Committee, Soil Mechanics and Foundations Committee

9:40 **A Unified System of Soil Classification**

G. E. BERTRAM, Office, Chief of Engineers, Washington, D.C.

10:30 **Discussion**

ARTHUR CASAGRANDE, M. ASCE, Professor of Soil Mechanics and Foundation Engineering, Harvard University, Cambridge, Mass.

11:00 **Military Application Implications of Soil Mechanics and Foundation Research**

D. J. MACLEAN and H. W. W POLLITT, Institution of Civil Engineers of Great Britain. Read by FRANK A. MARSTON, M. ASCE; Metcalf & Eddy, Boston, Mass.

Structural Division

9:30 A.M. **GEORGIAN ROOM**

Presiding: Jewell M. Garrelts, Chairman, Executive Committee, Structural Division

9:30 **Introduction to Nuclear Shielding**

H. M. GLEN, Assoc. M. ASCE; Supervising Structural Design Engineer, Oak Ridge National Lab., Oak Ridge, Tenn.

10:30 **Design Problems in Human Centrifuge Building**

SANKIS M. BAGDOYAN, Senior Structural Engineer, Bureau of Yards and Docks, Navy Department, Washington, D.C.

11:00 **Research in Reinforced Concrete**

R. F. BLANKS, M. ASCE; Chief, Research and Geological Division, U. S. Bureau of Reclamation, Denver, Colo.

11:10 **Reinforced Concrete Column Tests—Inelastic Behavior Under Eccentric Loads**

EVIND HOGNESTAD, Research Assistant Professor, University of Illinois, Urbana, Ill.

11:40 **Report of Thin Shell Committee**

CHARLES S. WHITNEY, M. ASCE; Ammann & Whitney, Consulting Engineers, Milwaukee, Wis.

11:50 **Design of Thin Shell Structures**

A. L. PARME, Assoc. M. ASCE; Portland Cement Association, Chicago, Ill.

Turnpike Construction Luncheon

THURSDAY, OCTOBER 25
12:30 P.M. **BALLROOM**

Sponsored by the Construction Division

Paul L. Troast, Chairman, and W. W. Wanamaker, Executive Director of the New Jersey Turnpike, discussing the Organization and Procedure of the New Jersey Turnpike Authority.

Toastmaster for the occasion: Elmer K. Timby, Chairman, Executive Committee, Construction Division.

Per plate: $3.50

Luncheon for the Ladies

THURSDAY, OCTOBER 25
PENN TOP NORTH

An opportunity to enjoy a luncheon prepared especially for the occasion by the Statler chefs.

Entertainment Features

Miriam Cordwell, official hair stylist of the N. H. C. A. will demonstrate hair styling and make-up.

Per plate: $3.00

Afternoon Division Sessions

Student Chapter Conference

THURSDAY AFTERNOON
OCTOBER 25 **SKY TOP**

2:30 Meeting of Student Faculty Advisers, Contact Members and others interested in the Student Chapters of ASCE

The Metropolitan Conference of ASCE Student Chapters is sponsoring this meeting of students from Chapters throughout the New York area. The program will feature participation of both students and practicing engineers.

New Jersey Turnpike Joint Session

Sponsored Jointly by Construction, Engineering Economics, Highway, Soil Mechanics and Foundations and Structural Divisions

2:30 P.M. **BALLROOM**

Presiding: Elmer K. Timby, Chairman, Executive Committee, Construction Division

2:30 **Economic Feasibility**

GEORGE W. BURPEE, M. ASCE; Partner, Coverdale & Colpitts, New York, N.Y., and ENOCH R. NEEDLES, M. ASCE; Partner, Howard, Needles, Tammen & Bergendoff, New York, N.Y.

3:15 **Design Standards: Construction Schedules and Problems**

CHARLES M. NOBLE, M. ASCE; Chief Engineer, New Jersey Turnpike Authority

4:00 **Stabilization and Foundation Problems Associated with the Installation of the New Jersey Meadow Section of the Thruway**

O. J. PORTER, M. ASCE; and L. C. URQUHART, M. ASCE; Porter & Urquhart Associated, Newark, N.J.

Entertainment for the Ladies

THURSDAY, 8:00 P.M. **SKY TOP**

The Sky Top of the Statler will be converted into a colorful Hawaiian resort through the resourcefulness of the United Air Lines. A program that will charm the audience, complete with native dancing, will be presented under the direction of Miss Bea Hansen, Director of the Women's Division for U. A. L. Admission by ticket only, no charge.

Men's Smoker and Show

THURSDAY, 8:00 P.M.
STATLER BALLROOM

Here's the evening to talk over old times with friends from round the globe, and to make some new friends too. This is noted for its informality, its excellent entertainment and for its never-ending refreshment for the tired traveler. All this and smoke too!

8–9 p.m.—A chance to get the evening started properly

9–10 p.m.—Acts from Broadway's best shows and night spots

10 on—Sandwiches, snacks, beer and coffee with bar service

Music throughout the evening for those that like to harmonize. Tables and chairs for those that like to sit awhile. Entertainment for those who like to laugh and whistle.

Note: To suit the convenience of those attending college dinners, the show has been timed so there is no need to miss any of the acts. Also note that a separate event has been planned for this evening to keep the ladies entertained elsewhere.

Friday Events, October 26

Morning Division Sessions

New Jersey Turnpike Joint Session

Sponsored Jointly by the Construction, Engineering Economics, Highway, Soil Mechanics and Foundations and Structural Divisions

9:30 A.M. — **BALLROOM**

Presiding: J. M. Garrelts, Chairman Executive Committee, Structural Division

9:30 **Hackensack and Passaic River Bridges**

O. H. AMMANN, M. ASCE; Partner, Ammann & Whitney, New York, N.Y., and ELLIS E. PAUL, M. ASCE; Partner, Howard, Needles, Tammen & Bergendoff, New York, N.Y.

10:15 **Design and Selection of Pavement**

JOHN R. DIETZ, M. ASCE; Chief, Highway Division, Gannett, Fleming, Corddry & Carpenter, Harrisburg, Pa., and

LESLIE M. STEWART, President, Stewart Associates, Inc., Cambridge Mass.

11:00 **Service Facilities**

STEWARD WAGNER, Partner, Fellheimer & Wagner, New York, N.Y.

Soil Mechanics and Foundations Division

9:30 A.M. — **KEYSTONE ROOM**

Presiding: Philip C. Rutledge, Chairman, Executive Committee, Soil Mechanics and Foundations Division

9:30 **Soil Stabilization Symposium**

Bureau of Yards and Docks

L. A. PALMER, Bureau of Yards and Docks, Washington, D.C.

HANS F. WINTERKORN, Assoc. M. ASCE; President, Winterkorn Institute, Princeton, N.J.

Corps of Engineers

T. WILLIAM LAMB, Assistant Professor, Massachusetts Institute of Technology, Cambridge, Mass.

For Support of Military Operations

FRANK C. TYRRELL, M. ASCE; Commander, CEC, U.S.N., Construction Battalion Center, Port Hueneme, Calif.

Clay Minerology and Soil Stabilization

JAMES A. HAVENS, Research Chemist, and W. A. GOODWIN, Assistant Research Engineer, Kentucky Department of Highways, Frankfort, Ky.

11:15 **Foundation Problems on Bridges and Slopes of New Jersey Turnpike**

J. D. WELCH; Howard, Needles, Tammen, and Bergendoff, New York, N.Y.

Soil Mechanics Luncheon

FRIDAY, OCTOBER 26

12:30 P.M. — **GEORGIAN ROOM**

Sponsored by the Soil Mechanics and Foundations Division

Per plate: $3.50

Afternoon Division Sessions

Soil Mechanics and Foundations Division

2:30 P.M. — **KEYSTONE ROOM**

Presiding: Philip C. Rutledge, Chairman, Executive Committee, Soil Mechanics and Foundations Division

2:30 **Design of Pavements**

GAYLE McFADDEN, M. ASCE; Head Engineer, Airfields Branch, Office, Chief of Engineers, Washington, D.C.

L. A. PALMER, Department of the Navy, Bureau of Yards and Docks, Washington, D.C.

3:00 **Soil Trafficability**

WILLARD J. TURNBULL, M. ASCE; Chief, Soils Division, U.S. Waterways Experiment Station, Vicksburg, Miss.

3:30 **Soil Trafficability as Related to Vehicular Mobility**

R. C. STEWART, U.S. Navy, Bureau of Yards and Docks.

4:00 **Mole Drainage for Landing Areas**

HOWARD M. WILLIAMS, Assoc. M. ASCE; Civil Engineer, Office, Chief of Engineers, Washington, D.C.

4:30 **Discussion**

THOMAS B. PRINGLE, M. ASCE; and GAYLE McFADDEN, M. ASCE; Office, Chief of Engineers, U.S. Army, Washington, D.C.

Turnpike Excursion

FRIDAY, OCTOBER 26

BUSSES LEAVE STATLER 12:30 P.M.

Through cooperation of the New Jersey Turnpike Authority an inspection trip will be made to major portions of the new 118-mile facility. Construction of interchanges, embankments, structures, pavements, service areas and toll plazas will be visited and explained by engineers in charge. Members and guests are invited. Ladies are welcome, but should be prepared for a rigorous inspection tour.

Transportation by bus leaves the Statler Hotel at 12:30 p.m. and returns at 5:00 p.m. Price per person, $1.50.

Ladies Excursion

Excursions are being arranged for the special interest of ladies attending the convention. Included among such destinations are the Radio City Music Hall, backstage, the National Biscuit Company's unusual plant and showrooms, and the new U. N. headquarters in Manhattan. Details of time and transportation will be included in later programs.

Sessions of the Board of Direction

The ASCE Board of Direction will be in session at the Board Room in the Engineering Societies Building at the following times:

Monday, October 22—10:00 a.m. to 5:00 p.m.

Tuesday, October 23—9:30 a.m. to 5:00 p.m.

Thursday, October 25—2:30 p.m.

College Reunions Scheduled

CHI EPSILON

Members of Chi Epsilon, their families and guests—men and women—will have their 17th Annual Luncheon at 12:00 noon on Tuesday, October 23, 1951, at Rosoff's Restaurant, 147 West 43rd Street near Times Square. Expense, $2.25 per person, complete. For reservations call Harold Larsen, Pennsylvania 6-9220.

CORNELL SOCIETY OF ENGINEERS

The Cornell Society of Engineers will hold a meeting on Monday evening, October 22, 1951, at 8:00 p.m. at the Cornell Club, 107 East 48th Street, New York, N.Y. For information call Secretary at Plaza 5-7210.

ILLINOIS CIVIL ENGINEERING ALUMNI

The University of Illinois Civil Engineering Alumni and their friends will meet for their 24th annual informal dinner on Thursday evening, October 25, 1951, at 6:00 p.m. at the Statler Hotel. A private dining room has been reserved. Dinner will be over in time to attend the ASCE Smoker in the evening. For further information and reservations call Milton C. Shedd at Whitehall 3-7980.

RUTGERS ENGINEERING ALUMNI

The Rutgers Engineering Alumni will meet before the ASCE Smoker on Thursday, October 25, at the Old Timers' Grill, 7 East 40th Street, at 6:00 p.m. Dinner will be over in time to attend the Smoker. Reservations should be made as early as possible through Carl Gronquist, Room 1104, 117 Liberty Street, Barclay 7-2616, or through Carl Rupp, 111 Eighth Avenue, Algonquin 5-1000, Ext. 315.

UNIVERSITY OF WISCONSIN ALUMNI DINNER

Engineering alumni of the University of Wisconsin will hold a dinner meeting at the Statler Hotel on Monday night, October 22 at 6:00 p.m. Dean M. O. Withey will be the speaker. Make reservations through Clarence Willson, American Iron & Steel Institute, 350 Fifth Ave., New York, N.Y. (Phone La. 4-5815.)

Post-Convention Trip to Bermuda and Nassau

Leave New York Saturday, October 27

On the Saturday immediately following the ASCE Annual Convention, a specially planned trip to Bermuda and Nassau is offered, for those who have earned a brief holiday. This luxury cruise presents opportunity for rest, relaxation, fun, a good get-together with a close circle of friends, and a real climax to the Annual Convention.

The luxurious Queen of Bermuda has been selected for the cruise. She was designed for world cruise accommodations, with comfort a prime consideration. For the ASCE cruise, excellent accommodations have been reserved in every price bracket.

The Itinerary

Oct. 27 Saturday at 3:00 p.m. sail from New York. See the famous bays and skyline. Tea, dancing, and other entertainment.

28 The Gulf Stream, daydreaming in your deck chairs. Movies, tea, swimming, dancing.

29 Bermuda. Enjoy the charming scenery of the North Shore from the "Queen" as she moves through the long Channel into Hamilton Harbor, conceded to be one of the loveliest small harbors in the world. Land at 9:00 a.m. Opportunity for a drive along the South Shore with its estates, around Harrington Sound, and visits to Devil's Hole, Crystal Cave, Perfume Factory, and Aquarium. Time for shopping, too. Sail at 3:00 p.m.

30 At sea with a complete program of shipboard entertainment.

31 Nassau. Proceed through the palm-bordered channel and arrive at anchorage at noon. There will be plenty of opportunity to make an excursion around the island, swim at Paradise Beach, visit the Marine Gardens, and shop for English-made goods. Paradise Beach is one of the most famous on the Atlantic Coast. Sail at midnight.

Nov. 1 Again at sea. Movies, dancing, swimming, horse races, bingo.

2 Snoozing in the deck chair, dreaming of another cruise in the future, or what will you?

3 Arrive New York at 9:00 a.m. A perfect holiday ended. We've been to Bermuda and Nassau.

The Inclusive Price

Prices begin at $197.35 and go up in easy stages, depending on the type of room selected on the ship. All prices cover room with private bath, all meals and every feature that the ship offers, as well as federal, Bermuda, and Nassau taxes. A deposit of $50.00 per person holds your place in the cabin that you select. Should you find later that you cannot go, your deposit will be refunded.

Your Reservation

Reservations must be made early. These Triangle cruises are very popular and the ship will be sold out long before sailing. Many will be making this the "high spot" of the summer vacation. Will you? Make your decision now.

Detailed Information

For the plan of the "Queen," rates, and answers to all cruise questions write direct to:

LEON V. ARNOLD
36 Washington Square West
New York 11, N.Y.

Mr. Arnold is in charge of all cruise arrangements.

Information and Registration

Information and registration facilities will be maintained in the Rotunda on the Convention floor of the Hotel Statler throughout the days of the convention. Mail and messages will be held for members at the Information Desk.

Hotel Accommodations

Headquarters of the Annual Convention will be the Hotel Statler, located on Seventh Avenue, between 32nd and 33rd Streets, directly opposite, and connected to, Pennsylvania Station. Special arrangements have been made to accommodate many convention visitors at the headquarters hotel, up to capacity, in the order that reservation requests are received.

Send your reservation request early to assure space at the headquarters hotel. For your convenience a special request form is provided in the advertising section of this issue. Late requests may have to be assigned to other nearby hotels.

Annual Convention Committees

William S. La Londe, Jr., *Chairman*
Raymond L. Brandes, *Vice Chairman*
John P. Riley, *Past Chairman*

Dinner—Dance

J. M. Garrelts, *Chairman*
Walter S. Douglas, Jr.
Richard Hazen

Division Luncheons

Eugene M. Itjen, *Chairman*
Edward Wininger
Richard Hazen

Excursions

Horace A. Vanderbeek, *Chairman*
Robert H. Dodds
Roger H. Gilman

Ladies' Entertainment

John R. Zehner, *Chairman*
Walter S. Douglas, Jr.
Richard H. Tatlow, III

Ladies' Committee

Mrs. Wm. S. La Londe, Jr., *Chairman*
Mrs. Raymond L. Brandes, *Vice-Chairman*
Mrs. John P. Riley, *Past-Chairman*
Mrs. Ford Bartlett
Mrs. Waldo G. Bowman
Mrs. William N. Carey
Mrs. E. L. Chandler
Mrs. Robert H. Dodds
Mrs. Walter S. Douglas, Jr.
Mrs. Arthur Fox
Mrs. Jewell M. Garrelts
Mrs. Morris Goodkind
Mrs. Richard Hazen
Mrs. Alfred Hedefine
Mrs. Eugene M. Itjen
Mrs. Arthur E. Poole
Mrs. Don P. Reynolds
Mrs. William J. Shea
Mrs. Kirby Smith
Mrs. Samuel D. Stickle
Mrs. Richard H. Tatlow, III
Mrs. Charles E. Trout
Mrs. Horace A. Vanderbeek
Mrs. Edward Wininger
Mrs. John R. Zehner

Membership Luncheon

Ford Bartlett, *Chairman*
Edward Wininger
Richard H. Tatlow, III

Publicity

Raymond L. Brandes, *Chairman*
Robert H. Dodds

Smoker

Samuel D. Stickle, *Chairman*
Eugene M. Itjen
Roger H. Gilman

SOCIETY NEWS

Division Programs Planned at Chicago Conference

The heavy responsibility assumed by the ASCE Technical Divisions for progress in engineering technique was stressed by President Gail A. Hathaway in the opening address at the Technical Procedure Conference in Chicago. To discharge such responsibility the officers of the fourteen Divisions planned new procedures and activities. Among developments discussed is a program to utilize many more engineers in the work of the Divisions.

Meeting at the Hotel Sheraton in Chicago on August 24 and 25, nearly 50 representatives of the Divisions and related committees studied ways to meet the expanding needs of ASCE membership for development of research, design and construction improvements. To finance such activities the largest budget ever proposed for Division use (almost $35,000) was recommended by the conference for adoption by the Board next October. Renewed emphasis was given to the cooperation of Divisions with Local Sections in the presentation of stronger programs at community level. On hand to urge such activity was Alfred J. Ryan, chairman of the Committee on Local Section Technical Coordination.

Programs for Conventions Planned

With an eye on developments for the ASCE Centennial Celebration, the conference worked with G. Donald Kennedy, chairman of the technical program for this 1952 event, on the extent of Technical Division participation in the program. A trend to cooperative sessions and symposiums seemed evident. Attention was also given to plans for the New Orleans and Denver conventions in 1952. B. M. Dornblatt, of New Orleans, and W. E. Blomgren, of Denver, presented highly constructive suggestions for these two conventions.

Engineering Society Cooperation Urged

In program planning, as well as in fields of standards, research, and production of manuals, greater cooperation with related societies is needed, said Elmer K. Timby, chairman of the Executive Committee of the Construction Division. He led discussions of new cooperative procedures that would avoid expensive and time-consuming duplication of effort which currently is manifest in some fields. One possibility suggested by Prof. Jewell M. Garrelts, chairman of the Structural Division, is the joint sponsoring of conferences in specialty fields. Professor Garrelts related the successful experience of his Division in such conferences, held apart from ASCE Conventions.

Division-Sponsored Conferences

Division-sponsored conferences were another promising development discussed by Col. George R. Schneider, chairman of the Executive Committee of the Hydraulics Division. Experience gained at the Jackson meeting of the Hydraulics Division proved the acceptance of such programs, said Colonel Schneider. More Division-sponsored programs are being planned.

Additional Personnel for Divisions

Many Division activities suffer because of shortage of men and proper organization, was the conclusion of a discussion led by Prof. Philip C. Rutledge, chairman of the Soil Mechanics and Foundations Division. To ease this shortage, Professor Rutledge told of plans of his Division to utilize the willingness and ability of Junior Members in the work of various committees. One such program sorely needing more man hours of attention is the publication effort of Divisions. Professor Rutledge described the operations of the publications committee which has been set up by his Division to facilitate the outlet for technical information in that productive field.

On hand to lead the discussion of publication policies and procedures of ASCE was Waldo G. Bowman, chairman of the Publications Committee. The increased capacity for publication of papers made possible by the adoption of the "Separates" plan was pointed out. Further effort on the part of the Divisions is essential to the success of this program, said Mr. Bowman. New procedures were mapped by the assembled Division officers.

Chairman for the Technical Procedure Conference was Fred C. Scobey, also chairman of the Division Activities Committee and senior Vice-President of ASCE Mr. Scobey presented current business to be considered by the conference, including organization of "joint" committees, formation of a Management Division, terms of office for Division officers, and other details of Division operation.

The possibility of making preprints of convention papers was discussed with procedures and costs by Don P. Reynolds, Assistant to the Secretary of ASCE. The need for early availability of the information presented at conventions was brought out. Financing of the program is yet to be worked out.

Civil Defense Efforts Needed

The attention of the Divisions was directed to the needs of the Civil Defense program by Professor Garrelts. The cooperative effort of the Divisions with military offices is needed, said Professor Garrelts, to utilize fully the abilities and knowledge of members of the Society. In similar fashion, the Divisions should have a more active part in the atomic energy program, said Alfred H. Wieters, chairman of the Sanitary Engineering Division. Needs and possible channels of productive cooperation were discussed

Attendance at the conference included the chairmen of Division executive committees, the men who will become the new chairmen at the October Annual Convention, members of the Division activities committee, Executive Secretary William N. Carey and Assistant Secretary E. L. Chandler, and members of the Local Section Technical Coordination Committee. Officers of the Illinois Section joined the conference for luncheon on August 24. Preceding and following the conference four Divisions held executive committee meetings.

ASCE Co-Sponsors First U. S. Conference on Prestressed Concrete

Latent interest in the fast-developing field of prestressed concrete has erupted into a notable series of meetings, held at Massachusetts Institute of Technology August 14–16, 1951. The occasion was the "First U. S. Conference on Prestressed Concrete" in which the Structural Division of ASCE was co-sponsor with professional and trade associations. Indicative of the widespread interest in the subject was the attendance of from 500 to 600 engineers.

The keynote of the congress was set by Leo H. Corning, M. ASCE, manager, Structural and Railway Bureau, Portland Cement Association, in an address, "Why Prestressed Concrete," presented at the opening session. "Historians of engineering progress will note this conference as a milestone marking a development of unusual significance to the construction industry," he said. "The importance of prestressed concrete is overshadowed only by the original development of reinforced concrete itself." He drew several conclusions from the evidence of European practice and the limited experience of engineers in the United States. It is his opinion that if prestressed concrete is adopted "with confidence in American construction practice," better and more economical structures under many conditions of service will result. In addition the material "will conserve our not inexhaustible supply of natural resources."

The program, closely following the announcement in the August issue (page 63), consisted of seven sessions divided into the general topics of applications, materials, design and research. It is planned to make the entire group of papers available for purchase later. In addition to the full program of papers, there were evening showings of films. There was also a continuous exhibition of photos and prestressing devices, illustrating methods developed in France, Belgium, Sweden, England, the United States, and elsewhere. The ingenuity apparent promises well for the vitality of this new application of an old method.

The "newness" was largely that of American viewpoint. While only two prestressed bridges have been built in the United States, many much larger structures have been developed in Europe. Whether the members were cast monolithically, or assembled from blocks before prestressing; whether the use was in buildings, pavements, piles, tanks, bridges, railroad ties or pipes; whether the reinforcement was grouted or left bare, the basic principle was the same. The main variations were shown to be in the methods of prestressing the concrete. Problems of construction, as distinct from design, were also frankly faced, with confession of errors. This same objective viewpoint was demonstrated by manufacturers in the submergence of commercial interest in favor of impartial offering of test and operational data.

As a result of the intense interest shown in this first series of meetings, the effort was crystallized into more definite form by continuance of the conference committee with instructions to formulate plans for a permanent organization.

SESSIONS OF FIRST PRESTRESSED CONCRETE CONFERENCE were held in huge main building (right foreground) on M.I.T. campus.

New ASCE Division Appoints Chairmen

Appointment for a two-year period of chairmen to the Advisory Board and various technical committees of the newly formed Engineering Mechanics Division of ASCE is announced by the executive committee of the Division. The appointees and their committee functions are as follows:

Harry N. Hill, chairman of the Advisory Board, which will have the duty of advising the Executive Committee on matters pertaining to awards, policies, appointments, and technical programs.

Mario G. Salvadori, chairman of the Committee on Applied Mathematics and Numerical Methods, which is to have the responsibility of developing and encouraging the application of analytical tools to civil engineering problems.

Dan H. Pletta, chairman of the Experimental Analysis and Analogues Committee, which is to foster the development and use of experimental methods and the utilization of techniques from other fields.

Hunter Rouse, chairman of the Committee on Fluid Dynamics, which will concern itself with promoting the study of basic problems in the flow of liquids and gases by analytical and experimental means.

Robert R. Philippe, chairman of the Committee on Mechanical Properties of Materials, which will have the function of investigating and correlating studies of the fundamental properties of engineering materials and of disseminating this information to the profession.

Daniel C. Drucker, chairman of the Committee on Plasticity Related to Design, which will study the phenomenon of plastic behavior in structures and application of the findings to design.

Merit P. White, chairman of the Committee on Structural Dynamics, which will study the behavior of structures under impulsive loading, including blast, earthquake and periodic forces.

All the technical committees of the Division will have the common purpose of formulating and developing studies and research in mechanics as they pertain to civil engineering problems, and of promoting coordination and cooperation with related groups in other societies and organizations.

E. G. Bailey Receives John Fritz Medal

Ervin George Bailey, past-president of the American Society of Mechanical Engineers and vice-president of the Babcock & Wilcox Co., has been selected by the John Fritz Medal Board of Award to receive the 1952 John Fritz Medal and Certificate "for outstanding engineering achievement in the field of combustion and distinguished service to his fellows in advancing the engineering profession."

Established in 1902 by friends of John Fritz to honor his contributions to the manufacture of steel and the advancement of industry generally, the John Fritz Medal is a joint award of the four Founder Societies.

The award to Mr. Bailey is the culmination of a long series of honors that have been bestowed upon him for his achievement and leadership in steam and combustion engineering and in professional activities. He assisted in the organization of the Engineers Joint Council and has been chairman of the Engineering Manpower Commission.

September 30 Is Closing Date for Yearbook Data

Members are reminded again that September 30, 1951, will be the closing date for making Yearbook changes in title or address. The cards mailed to members early in June should be filled out and returned at once if changes are needed. For the convenience of those who have misplaced the cards mailed them, a duplicate form appears on page 78 of this issue.

New Engineering Societies Monograph Is Available

Issuance of *Hydraulic Transients*, by George R. Rich, as eleventh publication in the Engineering Societies' Monographs series is announced by the Engineering Societies' Monographs Committee. The first adequate reference in the field since 1933, the 260-page publication is available for $7 from the publisher, the McGraw-Hill Book Co.

Publication of the monographs is made possible by cooperative action of the four Founder Societies, United Engineering Trustees, Inc., the Engineering Societies Library, and the McGraw-Hill Book Co., which since 1931 have had an agreement for the production of a series of selected books "adjudged to possess usefulness for engineers and industry."

The objectives of the arrangement are: "To provide monographs of high technical quality within the field of engineering; to rescue from obscurity important technical manuscripts that might not be published commercially because of too limited sale without special introduction; to develop manuscripts to fill gaps in existing literature; and to collect into one volume scattered information of special timeliness on a given subject."

ASCE Bulletin Studies Water and Sewage Rates

How should a utility, whether publicly or privately owned, compute and establish fair rates and fair-rate structures for water and sewage works? This basic question has been the subject of long study by an authoritative joint committee, with Sanitary Engineering Division representatives under Samuel A. Greeley, M. ASCE of Chicago, Ill., heading one group, and a similar committee of the American Bar Association Section of Municipal Law under John D. McCall of Dallas, Tex. Six other professional organizations cooperated. After almost three years of study the result is a joint report entitled "Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works" now available for distribution as ASCE Bulletin No. 2.

This valuable analysis has been published in the Ohio State Law Journal and is now offered as a 128-page sewed booklet in paper covers, available for purchase from the Society at $0.75 a copy.

Salary Survey Reprints Ready

Reprint copies of the seven-page article, "Survey of Salaries for Civil Engineering Positions—Spring 1951," conducted by the Committee on Salaries and published in the August issue, are available from the Executive Secretary ASCE, 33 West 39th Street, New York 18, N.Y. They are priced at 25 cents each for one to four copies or 10 cents each in lots of ten or more copies.

ASCE Director Walter Ryan Dies in Office

The sudden death of ASCE Director Walter J. Ryan—in Tacoma, Wash., on August 12—will come as a shock to his many friends in the Society. Mr. Ryan, who was 69, had had a consulting office in Tacoma since 1947. His term as Society Director for District 12 would have expired in January 1953.

WALTER J. RYAN
(1882-1951)

Mr. Ryan was with the Weyerhaeuser Timber Co. from 1914 to 1947, serving as engineer for the subsidiary companies—Snoqualmie Falls Lumber, Cherry Valley Logging, Columbia and Cowlitz Railway—and after 1923 as chief logging engineer at Tacoma. About a year ago he was in New Zealand, where he was engaged as consultant for the New Zealand Forest Service on matters of logging engineering. His earlier experience was with the Northern Pacific Railway and the U.S. Reclamation Service. A native of Nebraska, Mr. Ryan attended Oberlin College (A.B., 1903), Purdue University and Cornell University (C. E., 1906). He was especially interested in development of the proper use of timber as a structural material.

Elected an Associate Member of ASCE in 1910 and Member in 1919, Mr. Ryan helped in the organization of the Tacoma Section, which he served as president in 1933. He was active in ASCE committee work and served as chairman for the Society's Annual Convention in Tacoma in 1931. He had been president of the Pacific Logging Congress and was active in various forest products research organizations.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Legislation

The Defense Housing Bill, S. 349, was finally enacted by both Houses of Congress. It includes a provision for financial aid for community facilities other than schools in critical defense areas, not to exceed a total of $60 million. Credit Regulation X is relaxed. FHA receives an additional $1½ billion of mortgage insurance authority. There are provisions for assistance in producing prefabricated housing and for some public housing where needed.

A slash of 87 percent in the $535 million request for civil defense appropriations was accompanied by a House statement as follows: "The confidence of the American people in a civil defense program cannot be won by merely making larger appropriation of federal funds."

The House Civil Service Committee has approved proposed legislation which would give federal employees a pay raise of about $400 a year.

Control of the Point IV and other foreign-aid programs depends on reconciliation of House and Senate versions of proposed legislation. The House proposes to put all overseas assistance programs under a new Mutual Security Agency. Under the Senate proposal Point IV would remain with the State Department, the ECA would continue until July 1952, and the Defense Department would direct military aid. A considerable reduction in the administration's $8½ billion foreign-aid program is expected.

NPA Regulations

After several weeks of confusion during which regulations were issued, withdrawn, rewritten and reissued, a revised construction regulation M—4A, as amended August 20, 1951, seems to establish a new framework for construction operations. This regulation, together with CMP Reg. 6, as amended August 3, and Direction 1 to CMP Reg. 6, as amended August 22, should be in the hands of all engineers responsible for design or construction. Older orders, including Reg. M—4 and the August 3rd issue of Reg. M—4A, are obsolete.

The basic restriction stated in CMP Reg. 6 is as follows: "Except where otherwise specifically provided by NPA, no person shall continue construction that has been commenced or commence construction unless he has received an authorized construction schedule for such construction."

With reference to general engineering construction (excluding recreational and residential structures), NPA does "otherwise specifically provide" as follows in Order M—4A, Section 5 (*b*)(2), "A person shall not continue construction that has been commenced of any building structure or project . . . without submitting an application on Form CMP—4C, if his total requirements *for delivery after* September 30, 1951 . . . exceed the amounts specified (two tons of steel per project per calendar quarter).

Generally speaking, it is permissible to continue construction by the use of such materials as the owner or contractor has in his possession. The rules relate to granting of assistance in obtaining further supplies of critical steel, copper and aluminum. Everyone needing more than two tons of steel for delivery in the fourth quarter should file a CMP—4C application.

One point that is not clear is whether an owner or contractor having materials on hand, but also needing mill shipments of sizable amounts after October 1, may continue construction in so far as his available materials permit without having received his approved CMP allotment for the remaining materials. Informal conversations with top NPA officials indicate that this will be permitted. Their interest is in controlling deliveries of materials rather than in limiting construction. Of course until he actually receives the approval of an allotment, the engineer has no assurance that it will be forthcoming.

Special and stricter rules apply to recreational construction and multi-unit residential construction. In certain circumstances such construction cannot proceed even prior to October 1. A self-certification system is established for projects using small amounts of critical materials: two tons of steel and 200 lb of copper for general engineering construction; 25 tons of steel and 2,000 lb of copper for industrial plants per project per quarter; and from one to three tons of steel for residential buildings. The use of structural steel is prohibited in residential buildings.

The basic form for use in obtaining materials for construction is CMP—4C, which can be obtained at any U.S. Department of Commerce (NPA) field office.

In view of the almost certain shortage of controlled materials for construction in the last quarter of this year, essentiality will be the criterion for approval of materials allotments. Non-essential construction will not be dealt with liberally in the fourth quarter. The following classes of priority have been established:

1. Construction projects which will further the defense effort by providing facilities in areas adjacent to military establishments or defense plants, and also steel, aluminum, and aircraft facilities.
2. Construction essential to the public health, safety or welfare; other industrial facilities issued a certificate of necessity under construction before August 3.
3. Industrial construction issued a certificate of necessity but not started before August 3; also construction required as a result of disasters.
4. All other construction.

The situation with respect to steel will be unfavorable until about the middle of 1952 when some new facilities should begin production. The aluminum situation is about the same, but will get worse if further military aviation needs develop. The copper outlook appears dark for the duration.

Two NPA Divisions have been listed as additional claimant agencies—the Industrial Expansion Division and the Water Resources Division. The latter has jurisdiction over construction of facilities for water supply, including treatment, storage, and distribution, and facilities for sewage collection, treatment and disposal. These two divisions may be addressed through the National Production Authority, Washington 25, D.C.

Price, Wage and Salary Controls

In general Overriding Regulation 14, OPS exempts engineering fees from price regulations. The exemption does not apply to engineering firms engaged in the sale of equipment or in contract construction.

Wage-earning and salaried employees are under the control of the Wage Stabilization Board and the Salary Stabilization Board. The compensation of an employee to whom the provisions of the

ASCE MEMBERSHIP AS OF AUGUST 9, 1951

Members	7,934
Associate Members	10,205
Junior Members	14,492
Affiliates	68
Honorary Members	39
Fellows	1
Total	32,739
(August 9, 1950	29,340)

Fair Employment Practices Act apply or who is under a collective bargaining agreement is governed by rulings of the Wage Stabilization Board; others exempt as professional employees are governed by the actions of the Salary Stabilization Board, which generally follows the wage rulings where feasible. Currently both wage and salary ceilings are permissible at 10 percent over the January 15, 1950, level. A revision in Regulation No. 8, issued August 24, permits further cost-of-living adjustments in wages. It is very possible, but not certain, that salary ceilings may be adjusted similarly sometime in September.

Washington, D.C.
August 27, 1951

Coming Local Section Events

Illinois—Luncheon meetings at The Chicago Engineers Club on September 14, 21, and 28, at 12 noon. An evening joint meeting with the Mechanics Colloquium is scheduled for October 3.

Indiana—Annual meeting of Local Sections in District 9 Council, on September 22 and 23, at Clifty Falls State Park, Madison, Ind.

Los Angeles—Dinner meeting at the Alexandria Hotel, Los Angeles, on September 12, at 6:30 p.m., preceded by Junior Forum meeting at 6:00 p.m. The Sanitary Group meets at the Hotel Clark on September 26.

Philadelphia—Dinner meeting at the Engineers' Club, Philadelphia, on October 9, at 6:00 p.m.

Sacramento—Regular luncheon meetings at the Elks Club every Tuesday, at 12:30 p.m.

West Virginia—Annual meeting in the Club Room of the Daniel Boone Hotel, Charleston, on October 5 and 6.

Scheduled ASCE Conventions

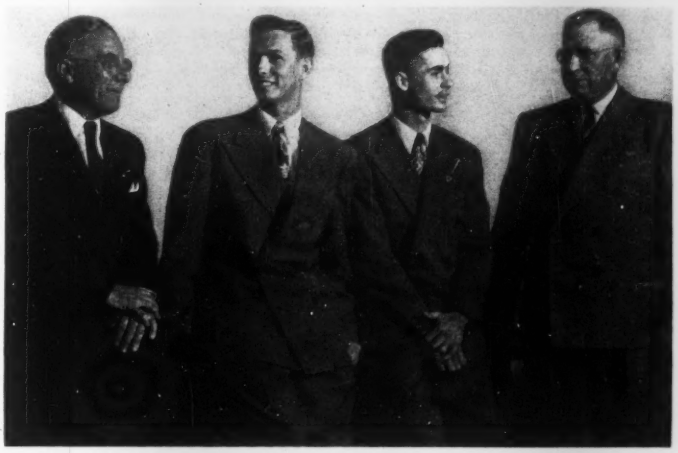
ANNUAL CONVENTION
New York, N.Y., October 22–26

SPRING CONVENTION
New Orleans, La., March 5–7, 1952

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Mid-South Jackson Branch	July 26	13	Monthly dinner meeting. A colored film on the design and construction of the U. N. Secretariat Building in New York was presented.
New Mexico	July 21	43	Summer meeting. Inspection tour of various construction projects at Los Alamos followed a business meeting. At the dinner meeting, President Lassetter introduced new members and officers. The guest speaker, G. B. Dwyre, Director of District 15, gave his observations as a Director. Col. Reuben E. Cole was toastmaster for the evening.
Puerto Rico	July 29	...	Annual outing and picnic for families and friends of members of the Puerto Section.
Sacramento	July 3	107	A colored film sponsored by the American Institute of Steel Construction, on various phases of structural steel construction, was featured at a luncheon meeting.
	July 10	96	Dr. Frank F. Tallman, director of the State Division of Mental Hygiene, spoke on "The Stress Analysis of Human Beings."
	July 17	132	The elevated viaduct which will carry traffic between Bay Bridge and Bayshore Highways was described by Leonard C. Hollister, Engineer of Design of the Bridge Department, State Division of Highways.
	July 24	66	George F. Hellesoe, Assistant State Highway Engineer in Charge of Maintenance, outlined the history of snow removal in California and illustrated his talk with slides.

President Hathaway Is Initiated Into Tau Beta Pi at Oregon State



ASCE PRESIDENT GAIL A. HATHAWAY, principal speaker at recent joint dinner meeting of Oregon State College Student Chapter and Tau Beta Pi chapter, is shown here with (left to right) Len Weber, president of Tau Beta Pi chapter; Darrell Hallegan, president of Society's Student Chapter; and Dr. Charles Mockmore, head of the college's civil engineering department. Preceding dinner President Hathaway, Oregon State alumnus was initiated into Tau Beta Pi.

NEWS BRIEFS . . .

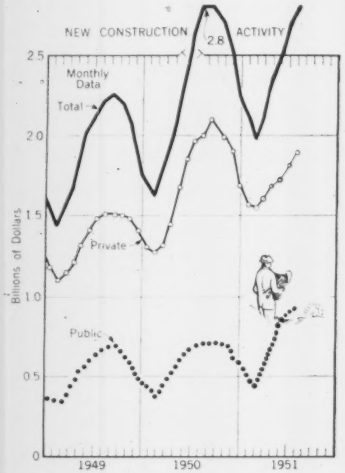
Construction Activity in July Shows Small Increase

New construction outlays for July, valued at nearly $2.8 billion, represented an increase of 3 percent over both the June 1951 and the July 1950 totals, according to preliminary estimates issued jointly by the Building Materials Division of the U.S. Department of Commerce and the U.S. Labor Department's Bureau of Labor Statistics.

This relatively small rise in construction activity is attributed to the increasing effect of restrictions on building. Private homebuilding activity failed to show the usual seasonal increase and was about 30 percent under last year's record rate. Commercial building began to drop, and there was a continued decline in construction of social and recreational facilities, the joint agencies report.

Construction of peacetime public works during the month gave way to atomic energy, defense plant, and military projects. Highway construction activity rose less than seasonally and was slightly under last year's figure. Reclamation and flood-control work was also off slightly from July 1950 levels, despite the fact that priority is given power-producing projects. Total public construction expenditures of $932 million were up 6 percent from June and 37 percent above July 1950.

Private outlays for new construction this July totaled $1,858 million—2 percent above the June total, but 8 percent below July 1950 levels. Expenditures for private construction during the first seven months of the year were 8 percent greater than in the corresponding period of 1950, compared with a 32 percent increase in outlays for public construction during the period.



NEW CONSTRUCTION IN JULY, representing 3 percent increase over both June 1951 and July 1950 figures, is shown here in Department of Commerce curves.

Navy Continues Large Construction Program

Two major projects in the expansion of the Naval Air Station at Alameda, Calif., have been placed under contract by the Navy Civil Engineer Corps. The jobs will cost $4,035,556. A contract for the extension and strengthening of one runway and the construction of an 8,000-ft landing strip has been awarded to the combined firm of Stolte, Inc., and Gallagher-Burk, of San Francisco, on a low bid of $2,886,556. Monson Bros., of Oakland, Calif., has been given a contract for $1,449,000 to construct an engine overhaul building together with all necessary utilities. The facilities will be ready for use next summer.

Another important California project will be rehabilitation of the Naval Auxiliary Air Station at Brown Field. The first contract in this project has been awarded to the Pacific Rock & Gravel Co., of Monrovia, Calif., for extension of a runway by 1,850 ft. The low bid was $1,137,000. Bids for two other Brown Field jobs, covering rehabilitation of 50 buildings, will be advertised soon.

Work is also proceeding rapidly on one of the Navy's largest West Coast projects—the Naval Radio Station at Arlington, Wash., which will be the nation's most powerful low-frequency communications outlet. Several contracts for construction of this $11,400,000 facility have been awarded during the past few weeks, and contracts for most of the other work will be let by October 30.

Recent award of a $2,320,000 contract for the construction of two buildings for the Fleet Air Defense Training Center at Dam Neck, Va., has also been announced. Low bidder was the Virginia Engineering Co., of Newport News, Va.

All-weather testing facilities in the Material Laboratory at the New York Naval Shipyard are now being completed, though the new units will be tried out for a period of six months before the project is accepted. With the 14 chambers and a refrigeration plant that comprise the facility, the Navy will be able to conduct complicated tests on electronic equipment under varied environmental conditions.

Ground Is Broken for Port Richmond Sewage Works

Ground-breaking ceremonies marking the start of construction of the Port Richmond Sewage Treatment Works took place recently, with Mayor Vincent R. Impellitteri the principal speaker and Frederick H. Zurmuhlen, M. ASCE, Commissioner of Public Works, presiding. The first modern sewage-treatment works to be built on Staten Island under New York City's $106,000,000 pollution-abatement program, the Port Richmond plant will have a capacity of 10 mgd. Cost of construction will be $2,500,000. A second Staten Island works—the 15-mgd Oakwood Beach Plant—is under design.

The city's five-year program to provide facilities for elimination of pollution from its beaches and waters provides for the construction of seven modern sewage-treatment plants with a combined capacity of 400 mgd. One of the seven, the 60-mgd 26th Ward Plant, went into service in May 1950 to provide full activated sludge treatment. The 120-mgd Hunts Point plant in the Bronx and the Owls Head (160-mgd) and Rockaway (15-mgd) plants in Brooklyn are in advanced stages of construction.

Contract Awarded for Atomic Power Facilities

The Westinghouse Electric Corp. has received a contract for equipment to carry electric power to the atomic energy plant at Paducah, Ky. The $6,700,000 contract was received from the F. H. McGraw Co., which is building the new plant for the Atomic Energy Commission. Included in the contract are large numbers of 40,000-000-kva circuit breakers, the largest ever constructed for use on 161-kv lines; many low-voltage circuit breakers and unit substations; and five 100,000-kva transformers.

New Aluminum Plant to Be Fueled by Lignite

A new aluminum smelting plant, the first in history to use lignite (sub-bituminous coal) for fuel, will be built by the Aluminum Company of America on a site near Waco, Tex. The large amounts of electricity required in aluminum manufacturing will be generated by steam-driven equipment fueled by extensive deposits of lignite in the area. Use of lignite as a major source of low-cost power has recently been made possible by the Texas Power & Light Co., which sponsored an extensive research and experimental program, and by the U. S. Bureau of Mines, which carried out the project in a pilot plant at Denver, Colo.

The new plant, which will have an annual production capacity of 85,000 tons of aluminum, represents another step in the company's program of expansion to meet defense and increased civilian needs for aluminum. Production of metal is expected to start in the early fall of 1952.

Army Speeds Defense Projects in Alaska

Award of several large Alaska District Engineer contracts for defense projects is announced by the Corps of Engineers. In bids received from contractors all over the United States for construction of outside utilities at Ladd Air Force Base, Peter Kiewit Sons, of Omaha, Nebr., led the competition with a low bid of $8,493,313. This contract will provide for construction of outside utilities in both the Army and Air Force areas at Ladd Air Force Base.

Construction of an Army Communication Station at Kenai, Alaska, will also proceed with award of a $6,329,364 contract to the New York City firm of Grove, Shepherd, Wilson & Kruge. The multi-item project will include a barracks, operations and headquarters buildings, and the utilities to serve them.

Fifth Pan-American Highway Congress to Meet in Peru

The Fifth Pan-American Highway Congress—to be held in Lima, Peru, October 8–15—will bring together for the first time in ten years representatives of all the American republics in an attempt to coordinate development of highways and highway transportation in the Western Hemisphere. In addition to the official delegation, representatives of non-official groups, including business and industry, may attend the conference as observers.

The congress will consider all phases of highway construction, maintenance and improvement, highway uses, and the Pan-American Highway System. There will also be a round-table discussion on the program of the U.S. Technical Cooperation program for aiding the development of highways and highway transportation in Latin-America.

Both the International Road Federation and the Federation of Inter-American Automobile Clubs will hold meetings in conjunction with the Congress, which will include inspection trips over sections of the Pan-American Highway, exhibits and displays, and a number of social events as well as the technical program. Congress headquarters will be the Palacio Municipal of Lima which, in addition to housing the municipal offices, contains priceless collections of art.

Established in Buenos Aires, Argentina, in 1925, the Pan-American Highway Congress last met in Mexico City in 1941. Information concerning the present congress may be obtained from the International Road Federation, 550 Washington Building, Washington 5, D.C.

Delaware Memorial Bridge Is Opened to Traffic

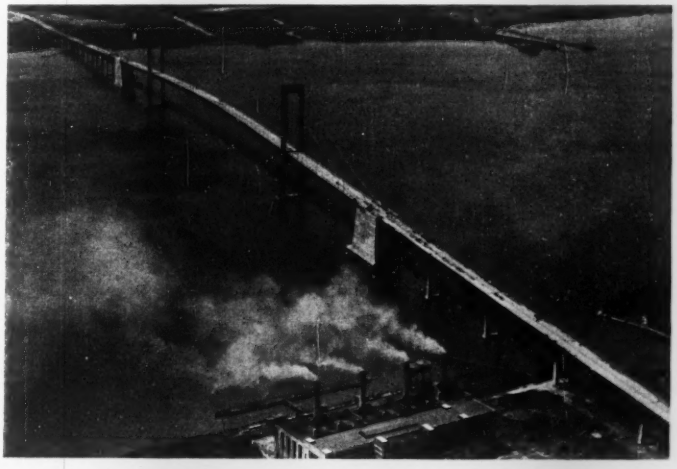
Opening of the $44,000,000 Delaware Memorial Bridge across the Delaware River between southern New Jersey and northern Delaware, on August 15, was hailed by the governors of both states as an important development in expediting traffic between the North and the South, in the dedication ceremonies. President Truman, in a message to Governor Carvel of Delaware, said that the bridge will be "not only a boon to the motoring public and commercial transport, but in time of national defense a necessary utility." It will connect Delaware's du Pont Highway with the New Jersey Turnpike, now nearing completion.

Opening of the highway will end ferry service between Pennsville, N.J., and New Castle, Del., which has long constituted a serious traffic bottleneck. According to engineering estimates, the bridge will carry an average of 13,000 vehicles a day during its first year and 21,000 a day during its tenth year. It will have a peak capacity of 30,000 vehicles a day, in comparison with a reported daily capacity of 8,000 vehicles for the ferry.

Begun in 1947 as a memorial to the war dead of both states, the new four-lane Delaware River crossing is the sixth longest suspension span in the world. It has an over-all length of $3\frac{1}{2}$ miles, including an actual bridge length of 10,765 ft between abutments. Underclearance of 175 ft above high water for a channel width of 1,500 ft is provided.

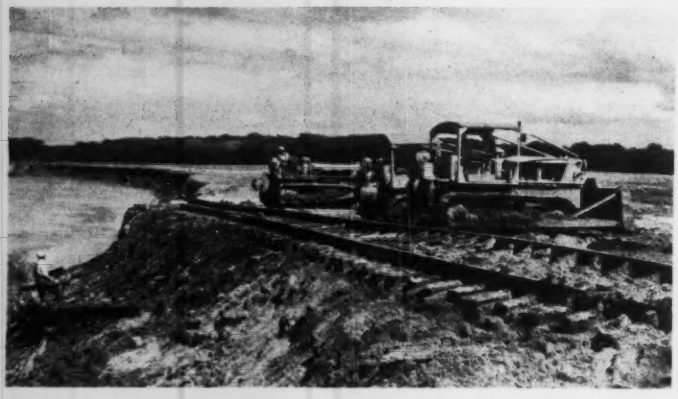
With most of the site of the Delaware Memorial Bridge within the State of Delaware, the State of New Jersey passed enabling legislation so the entire project could be built, owned, and maintained by the State of Delaware. Engineers for the state were Howard, Needles, Tammen & Bergendoff, of Kansas City and New York, with O. H. Ammann, M. ASCE, and Moran, Proctor, Freeman & Mueser, of New York, as consultants. The substructure was constructed by Merritt-Chapman & Scott, and the superstructure by the American Bridge Co., a subsidiary of the United States Steel Corp.

Various construction phases of the project were described in the November 1949 and November 1950 issues.



NEW SUSPENSION BRIDGE across Delaware River just south of Wilmington, opened to traffic on August 15, constitutes vital artery in north-south traffic flow.

Heavy Equipment Speeds Clean-Up in Midwestern Flood Area



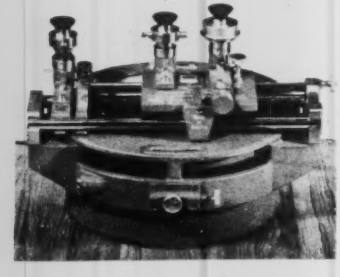
VAST CLEAN-UP OPERATION in wake of disastrous billion-dollar flood in Kansas-Missouri area is expedited by use of heavy equipment, though job of removing debris and restoring facilities will require many months. Railroad facilities in hard-hit areas of Kansas City and Topeka have to be cleared for action and rebuilt in many cases. Rolling stock lost in Kansas amounted to 22,100 cars, while losses in Missouri totaled 65,000 cars. Here C. H. Fauerbach, contractor of St. Mary's Kans., has two Caterpillar D6 Bulldozers and one D7 Bulldozer on the job of pulling a half mile of washed-out Rock Island tracks back to dry land near Topeka, where the flooding Kaw River inundated several million acres of land. Five Kansas contractors, pooling their resources under the name of Topeka Disaster, Inc., are still cleaning up street and sewer facilities in badly flooded North Topeka. Photo courtesy of Caterpillar Tractor Co.

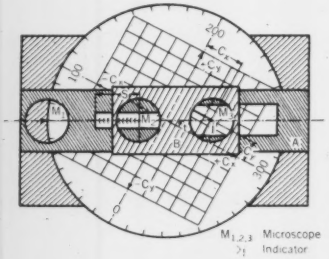
Instrument Mechanically Computes Coordinates

An instrument, called Coorapid, is being manufactured by R. & A. Rost, Vienna, for mechanical computation of rectangular coordinates of survey traverse points without the use of either tables of trigonometric functions or calculating machines.

According to Serge A. Emery, civil engineer of Freeport, N.Y., who furnished the accompanying photograph and sketch, and material from which this release is prepared, the Coorapid instrument consists of a horizontal circle graduated in minutes on which the azimuth of the course is set to an accuracy of 0.1 min, by a microscope M_1 attached to the fixed frame, A (See Fig. 1); and a platform, B, which is moved along an immobile diameter of the graduated circle, and to which microscopes, M_1 and M_2 are attached. When the azimuth of a course is set under microscope M_1, and the length of the course is set under microscope M_2, the rectangular coordinates of the corresponding point may be read under microscope M_3.

The instrument is said to give results equal to those obtained by the use of five-place tables of trigonometric functions. It readily solves other types of problems involving rectangular triangles, such as reducing lengths measured on a slope to the horizontal; determining bearing and distance from coordinates; orientation in photogrametry; and checking higher-order computations of coordinates. In the United States and Canada the instrument is sold by Geo-Optic Co., 2416 Atlantic Ave. Brooklyn, N. Y.





Large Titanium Plant Will Be Built in Nevada

The first large-scale and self-contained plant for production of titanium metal will be constructed at Henderson, Nev., by the Titanium Metals Corporation of America, a company owned jointly by the National Lead Co. and the Allegheny Ludlum Steel Corp., under the terms of a recent contract with the government. A contract for engineering and constructing the $14,000,000 plant has been awarded the H. K. Ferguson Co., industrial engineers and builders of Cleveland, Ohio.

To be located on the site of a wartime magnesium plant built by the government and operated by Basic Magnesium, Inc., the project will utilize various major components of the former plant and require a minimum amount of new construction. Terms of the contract with the government call for initial production of 3,600 tons of titanium metal a year, and operations are expected to reach this level by late 1952. The Colorado Power Commission has allocated an annual power supply of 151,000,000 kwhr, generated at nearby Hoover and Davis dams, for operation of the plant, which will include the production of titanium sponge and the melting of titanium metal into ingots. Present world production of titanium is only 500 tons a year.

A certificate of necessity covering the project has been signed by the government in response to an urgent demand from both military and atomic energy agencies for titanium metals and titanium-base alloys, with their exceptional physical properties.

Army Engineers Let Contract for Fuel Storage Facility

A $1,557,290 low-bid contract for construction of a fuel bulk storage facility at North Charleston, S.C., has been awarded to the Merritt-Chapman & Scott Corp. by the Charleston District of the Corps of Engineers. The project will include construction of two 18-in. overground parallel pipelines running 2½ miles from an existing dock on the Cooper River to a new tank farm to be erected on 45 acres of wooded terrain, which will be cleared and graded as part of the contract. The pipeline will be supported by concrete piers.

The project will be under the over-all direction of Col. C. L. Landaker, district engineer, with Capt. Charles Wilson, Jun. M. ASCE, in charge of the work for the Corps of Engineers.

Production of Steel at New High for Six-Month Period

A sharp rise in steel production for the first half of the year over the same period in 1950 is reported by the American Iron and Steel Institute. The record high total of finished steel shipped in the first half of 1951 was 40,006,000 net tons—an increase of 5,442,000 tons, or 15 percent, above the first half of 1950.

Though much of this increase went to industries that are always large consumers of steel, such as railroads, oil-well drilling, machinery and shipbuilding, the amount of steel provided for direct defense purposes rose sharply in the period. Makers of aircraft, guns, tanks, and similar products received nearly 500,000 tons more steel than in the corresponding period of 1950. In June, direct shipments of steel for the manufacture of ordnance and other military goods were nearly 105,000 net tons, almost twenty times more than shipments last June.

Fulbright Awards in Engineering Announced

Availability of opportunities for university lecturing and post-doctoral research awards under the Fulbright Act is announced for the academic year of 1952–1953 by the Conference Board of Associated Research Councils.

The program for Europe and the Near East includes openings for visiting lecturers in hydroelectric engineering at the Institute of Technology, Trondheim; in hydrodynamics at the University of Oslo; in civil engineering, with specialization in prestressed concrete, at the University of Ghent; in fluid mechanics and applied hydraulics at the University of Technology, Vienna; in hydraulic power development and hydrology and in soil mechanics and foundation engineering at Fouad I University, Egypt; and in roads and transportation and in sanitary engineering at Farouk I University, Egypt.

A research scholarship in sanitary engineering is available at Milan Polytechnic Institute. The visiting scholar would also be requested to give a short course of lectures and seminars in the field. These lectures would be delivered in Italian, and German is required for the lectures in fluid mechanics and applied hydraulics at the University of Technology in Vienna. The other lectures listed may be given in English.

The closing date for making application for these Fulbright awards is October 15, 1951. Applications for awards in any subject will also be accepted for Greece and Turkey, though details of the programs in these countries have not yet been worked out. Inquiries should be sent to the Conference Board of Associated Research Councils, Committee on International Exchange of Persons, 2101 Constitution Avenue, Washington 25, D.C.

Monorail Transit System Planned for Los Angeles

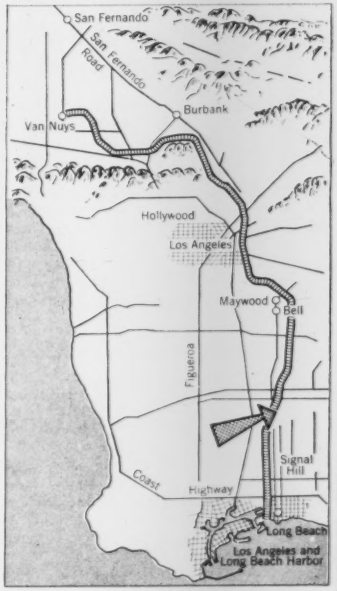
A bill authorizing the creation of a Los Angeles Metropolitan Transit Authority, with power to build and operate a monorail overhead transportation system for relief of traffic congestion in metropolitan Los Angeles, was signed by Governor Warren on July 24. The proposed 44-mile monorail system which has been under discussion for some years, would follow the Los Angeles River bed between the San Fernando Valley and Long Beach.

It would consist of two rails—one for incoming and the other for outgoing cars—mounted on V-shaped steel supports spaced approximately 70 ft apart. Cars, suspended on two wheels each, would run singly or together in trains of up to five. They would travel 16 ft above the ground, rising occasionally to clear obstructions or dipping under a bridge. The cars would be propelled by electric motors, encased in the wheel mountings, at an average speed of 38.1 mph, compared with the present average speed of about 9 mph for surface rail transportation. Concave rollers mounted on the top of each car would prevent derailment at speeds up to 55 mph.

Passengers, served by feeder bus lines, would board the monorail by escalators paying their fares at turnstiles. The newly created transit authority will be granted power to operate feeder bus lines to the monorail if existing transportation facilities are not adequate.

Monorail development in Southern California is being handled by two affiliated private organizations—the Monorail Engineering & Construction Corp., which is concerned with actual construction of the system, and the Southern California Monorail & Transit System, Inc., which was organized to promote the monorail plan until the transit authority can take over. Before the bill signed by Governor Warren goes into effect federal authorization must be obtained. Final right-of-way procurement will also be required from the city and the Los Angeles County Flood Control District.

The total cost of the proposed system is estimated at between $60,000,000 and $80,000,000 for the route described. This would make the cost per mile about $1,500,000, compared with an estimated $10,000,000 a mile for a subway. Present plans for financing call for underwriting by the National Security Resources Board on the basis of the system's defense importance. The loan would be repaid by the sale of revenue bonds.



ROUTE OF PROPOSED 44-MILE MONORAIL SYSTEM is shown here. This map is reproduced through courtesy of "The Los Angeles Times."

ECA Inaugurates $250,000,000 Philippine Development Program

A five-year drive to expand production and open new lands in the Philippines has been launched by the Economic Cooperation Administration, following the recent signing of a bilateral agreement between the United States and Philippine governments. According to the *Philippine Newsletter*, which reports the program, "significant improvement has already been made in the Philippine economic picture as a result of carrying out the United States pre-conditions in offering this aid." These conditions include legislation to balance the budget and to establish a minimum wage law and other fiscal and social reforms. As a counterpart to United States expenditures, the Philippine government will match dollars with pesos at the rate of two to one, this fund to pay for local costs of service and materials.

The ECA program, which will total $250,000,000, with $15,000,000 being spent by the end of 1951, will concentrate at the outset on acceleration and expansion of existing sources of production by the use of fertilizer and irrigation and the building of roads to give access to undeveloped lands. Public health, considered as both a social and economic need, will be another top-priority project.

Technical specialists from the United States are assisting Philippine government agencies in working out the plan. Los Banos College of Agriculture, which will serve as a base for bringing agricultural know-how to the farmers, has already received shipments of fertilizer and equipment.

Work on Turnpike Extension Nears Completion

CONSTRUCTION RECORDS TOPPLE as 67-mile Western Extension of Pennsylvania Turnpike System nears completion. Construction crew of L. G. Defelice & Son Co., of North Haven, Conn., is shown at work on 6,166-ft stretch of concrete, 12 ft wide, which was laid in single day, establishing all-time record. Ten-mile stretch of the new Western Extension from Irwin to the Pittsburgh Interchange, near Monroeville, was opened to traffic on August 7. With completion of Western Extension in October, the 327-mile Pennsylvania Turnpike System will traverse almost the entire state. Recent legislation will permit the Pennsylvania Turnpike Commission to construct a link east from the present Philadelphia Extension called the Delaware River Extension. Connecting by bridge across the Delaware River with an extension of the New Jersey Turnpike, proposed extension will make possible a limited-access, superhighway system from the George Washington Bridge to the Ohio border. Photo courtesy Pennsylvania Turnpike Commission.

Water Conservation Program Combats San Diego Drought

Steps being taken by the City and County of San Diego to cope with the worst drought ever experienced in the area are described in a recent release from M. J. Shelton, a director of the San Diego County Water Authority and chairman of the San Diego County Water Conservation Committee. The situation is aggravated, Mr. Shelton notes, by recent large increases in population resulting from the greatly expanded military program and rapid industrial development of the area.

With last winter's runoff one of the lowest on record and with delivery of Colorado water through the San Diego Aqueduct not equalling consumption, it became apparent early this year that something must be done, Mr. Shelton states. Studies made by the San Diego County Water Authority disclosed that water in storage throughout the county totaled only 17 percent of capacity, a gradual reduction having been in progress ever since 1944 when the last above-normal runoff occurred. It was found that, even with normal use, a total of 118,000 acre-ft would be required by the San Diego County Water Authority agencies making up the membership of the organization, whereas the aqueduct is capable of delivering only 73,000 acre-ft, even if pushed beyond its normal capacity by careful operation and chlorination to eliminate slime growth. Since there have been five years of subnormal runoff since 1944, it is reasonable to assume that runoff will continue subnormal during the coming winter. This condition, Mr. Shelton says, would result in exhaustion of all the reservoirs by the end of 1952 even if the aqueduct is kept to maximum delivery.

Early in April a county-wide Citizens' Water Conservation Program was organized, and a special six-man water-conservation committee appointed by the San Diego County Water Authority. Local conservation committees have also been formed to give wide publicity to the program. The initial stages of the program were financed by a special appropriation made available by the Water Authority, and a finance committee of the Water Conservation Committee has raised sufficient funds through a general assessment program to finance the publicity program for the rest of the year.

Early in the program a "Target Day" was established, with the goal of reducing normal consumption in the City of San Diego from 51,000,000 gal per day to 34,000,000 gal. The first "Target Day" almost reached the goal by cutting down consumption to 38,550,000 gal. Daily newspaper, radio, and television publicity keep before consumers the results of their cooperation by comparing consumption figures with those for the same day a year ago. The Plumbing Contractors Association has also published a series of articles showing the consumer how to make plumbing repairs to eliminate leaking fixtures, and special "Fix-It Days" are also being observed. Over a period of three months, the conservation program has reduced water consumption by 20 percent, but even so, storage has fallen to about 14 percent.

As a more fundamental means of correcting the situation, the San Diego County Water Authority, with a membership of ten water agencies representing about 80 percent of the water used in the county, has for the past two years been taking preliminary steps toward construction of the Second Barrel of the San Diego Aqueduct. The cost of this project is estimated at approximately $18,000,000, repayable over a 40-year period by the San Diego County Water Authority. During construction of the original aqueduct, all tunnels were built to full capacity, whereas the other aqueduct features were constructed to only about 50 percent of capacity. Preliminary engineering and feasibility reports, made by the Navy and the Bureau of Reclamation at the request of the Water Authority, have been completed. At best, however, the Second Barrel will not be able to deliver water until the 1953–1954 season. This, Mr. Shelton says, makes particularly urgent the success of the water conservation program.

Boston to Have Central Wholesale Produce Market

An interest-free advance of $78,000 to assist the Massachusetts Market Authority in making plans for a new centralized wholesale produce market for Boston has been approved by the Housing and Home Finance Agency. The project, which is estimated to cost about $18,500,000, will replace the Faneuil Hall Market District that will be largely demolished to provide right-of-way for the new arterial highway system through the city being built by the Massachusetts Public Works Department.

Occupying a 170-acre site in South Boston, the project will require acquisition and razing of privately owned buildings and railroad facilities and relocation of considerable trackage. Complete drainage and sewer systems will be required, together with a system of water mains. Sea-wall protection will be necessary along the South Bay frontage, and plans call for reclaiming about 8½ acres of water area.

Engineers on the project are Praeger-Maguire, of New York, and the Boston engineering firm of Fay, Spofford & Thorndike.

Army Approves New Texas Flood Control Project

A plan to construct a dam and reservoir near Gonzales, Tex., and make channel improvements at San Antonio and Kenedy, Tex., has been tentatively approved by the Army Board of Engineers for Rivers and Harbors. Recommended by the Fort Worth District Engineer, the plan provides for a dam and reservoir at Mile 5.4 on the San Antonio River and tributary streams at San Antonio, Tex. Objectives of the plan are flood control and water conservation.

Prestressed Concrete for Industrial Building Studied

More than 150 engineers, building code officials and representatives of engineering schools and technical societies witnessed tests to destruction of a 40-ft prestressed concrete beam and a 60-ft prestressed girder conducted by the Austin Company at its Bliss Mill Division in Euclid, Ohio, on August 9. The tests followed a year and a half of research by the company's engineers into the potentialities of prestressed concrete in commercial and industrial building. The current critical shortage of steel emphasizes the need for a material suitable for building frames. A prestressed building requires no more than 25 percent of the steel required in a structural steel building.

The 40-ft beam and the 60-ft girder were chosen because of the general acceptance in the United States of 40- and 60-ft column spacing as the desirable minimum. While prestressed concrete construction has been used widely in Europe, in the United States it has been applied almost exclusively to tanks, and to a few bridges. Its use in large industrial buildings has not been recorded.

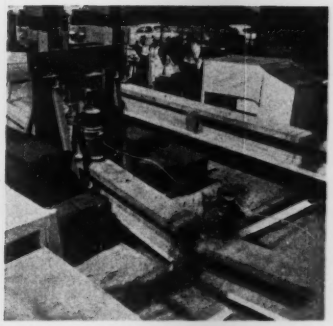
The tests by Austin engineers were made to gain first-hand knowledge about practical construction problems, such as the use of low-slump high-early-strength concrete; the handling, cutting, and placing of high-strength (over 200,000 psi) prestressing steel wires; and the use of vibrators. The tests were also devised to establish confidence in the use of prestressing methods, materials, and equipment.

The 40-ft beam, designated F-40, was designed by the Freyssinet Co., of New York. The dimensions of the I-section at mid span were: depth, 26 in.; top flange, 18 in. wide and 5 in. thick at edges; web, 5 in. thick; and bottom flange, 12 in. wide and 4 in. thick at its edges. The beam, F-40, was reinforced with 48 wires, in four cables of twelve 0.192-in. dia wires, having an ultimate strength of 230,000 psi. The cables were grouted in a 1-in. flexible steel conduit. Test loads were applied at approximate one-third points. Between load points $\frac{1}{4}$-in. mild steel reinforcement was spaced on 12-in. centers, and six $\frac{1}{4}$-in. longitudinal bars of mild steel were placed in the top and bottom of the beam. The beam was designed to carry 15,000 lb at each load point, based on 5,000 psi concrete and 120,000 psi stress in the prestress wires after relaxation. Under test first hair-cracks appeared at 70,000 lb, and the break came at a load in excess of 117,000 lb and a deflection of over 4 in.

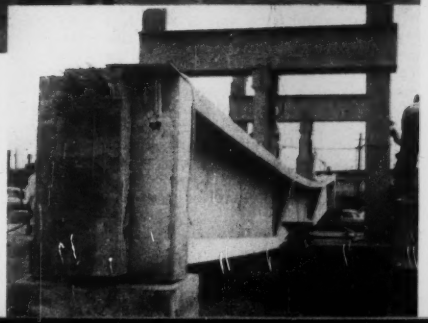
Tested to destruction also was a 60-ft girder, F-60, having a modified T-section. The girder was also designed by the Freyssinet Co. At mid-span the girder was 40 in. deep; its top flange was 30 in. wide and 5 in. thick; and its web 6 in. thick widened to 12 in. for the bottom 7 in. Reinforcement consisted of 96 0.192-in.-dia, 210,000-psi wires, in eight cables of twelve wires each. Between the load points, $\frac{1}{4}$-in. mild-steel stirrups were placed on 12-in. centers, and four $\frac{3}{8}$-in.-dia and eight $\frac{1}{4}$-in.-dia longitudinal bars were placed—six in the top and six in the bottom of the beam.

Girder F-60 was designed for a load of 50,000 lb—25,000 lb at each load point—based on 5,000-psi concrete and 120,000-psi in the wires after relaxation. Under test this girder broke under a load of 200,000 lb when the concrete under one of the jacks which was applying the load crushed enough top-flange concrete to cause failure.

The Austin Company's research program is under the guidance of J. K. Gannett, M. ASCE, vice-president and director of engineering and research. Mr. Gannett presented detailed results of the tests and preliminary conclusions in a paper presented at the First U. S. Conference on Prestressed Concrete held at MIT on August 14–16, mentioned elsewhere in this issue.



TENSION IS BEING APPLIED to 40-ft concrete I-beam in left-hand photo. Twelve 0.192-in.-dia wires, forming each of four cables, are tensioned and anchored simultaneously. Watching operation are R. M. Dubois, president of Freyssinet Co., Inc. (left); A. T. Waidelich, M. ASCE, vice-president and manager of research of the Austin Co. (center); and Niels Thorsen, Freyssinet engineer. First hair cracks appeared at 70,000 lb and rupture (photo at right) came under load of over 117,000 lb when deflection measured over 4 in.



IN INSET, 60-ft T-section girder, 40 in. deep, is prestressed with 96 0.192-in. 230,000-psi wires stressed to 120,000 psi after relaxation. Designed to carry 50,000 lb, girder supported 200,000 lb at failure.

Neale's News Column

R. Robinson Rowe, M. ASCE

"It's up to you tonite, Cal. Joe Kerr is on a vacation, the coward! Guest Professor Othernut wrote me, 'Still sick in bed with a doctor. Hoping you are the same, LXXX. /s/ Anne.' So how far did the business end of Paul Bunyan's toothpick overhang the rear axle to minimize bending stress?"

"Just 100 ft," answered Cal Klater.

"Make him prove it," demanded Ken Bridgewater. "My 13 pages of equations got me nowhere. It really was a dilly."

"Then I'll outline mine," said Cal. "The sketch shows the conical toothpick on two axle supports and a graph of the bending stress in the extreme bottom fiber. We must find the overhang x if $f_x = f_y = -f_z$. Pitch and weight will cancel out, so for U we can let the section modulus $S_u = q^{-1}u^3$ and the weight to the left $W_u = 4pu^3$. Then, for the middle span:

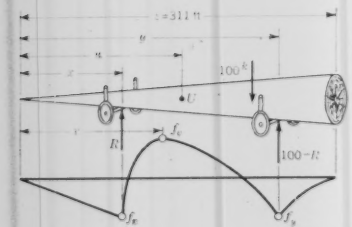


FIG. 1. To minimize stress in Paul Bunyan's toothpick, x = 100 ft made $f_x = f_y = -f_z$

$$R = pz^3(4y - 3z)/(y - x) \quad . \quad . \quad (1)$$

$$V_u = R - 4pu^3 \quad . \quad . \quad . \quad . \quad (2)$$

$$M_u = R(u - x) - pu^4 \quad . \quad . \quad (3)$$

$$f_u = pq\left[\frac{z^3(u - x)}{u^3(y - x)}(4y - 3z) - u\right] \quad . \quad . \quad (4)$$

When we equate f_x and f_y:

$$-pqx = pq[z^3y^{-3}(4y - 3z) - y] \quad . \quad (5)$$

$$z^3(4y - 3z) = y^3(y - x), \text{ making} \quad . \quad (6)$$

$$f_u = pq[y^3u^{-3}(u - x) - u] \quad . \quad . \quad (7)$$

$$f_u' = pq[y^3(-2u^{-3} + 3xu^{-4}) - 1] \quad . \quad (8)$$

Which is zero when $u = v$, so

$$y^3 = v^4/(3x - 2v) \quad . \quad . \quad . \quad (9)$$

Substituting in (7) and equating to $-f_z$:

$$f_v = pq(3v^2 - 4vx)/(3x - 2v) = pqx \quad (10)$$

$$3v^2 - 2xv - 3x^2 = 0 \quad . \quad . \quad (11)$$

$$3v = x(1 + \sqrt{10}) \quad . \quad . \quad (12)$$

"You make it look so utterly simple," interrupted Ken, "Next, I suppose, you substitute (12) in (9) and then in (6) to get an equation in just x and z."

"Right, and since z = 311, it leads to:

$$y = 2.5436484x \quad . \quad . \quad . \quad (13)$$

$$x^4 - 12{,}047{,}000x + 1{,}104{,}700{,}000 = 0 \quad (14)$$

so that x = 100 ft, as nearly as I could figure."

"Near enuf, Cal," conceded the Professor. "Anne and I couldn't set this one in integers, but we did pretty well. More precisely, x = 99.99972.

"For next time, Guest Professor Sauer Doe has contrived a hare-razing problem. Let's let him tell it."

"The hare, Noah, was named Aaron. He was idly browsing in the southeast corner of a square 10-acre field when he spied two hounds, Bugler and Caesar, in the northeast and northwest corners. He set out at top speed for his hole in the southwest corner, but at the same instant the hounds spied the hare and started the chase, running always directly toward him at 40 ft per sec. It was a 3-cornered race with Aaron losing ignominiously to both hounds at once. How far was he from his hole, and how much faster should he have run to make it?"

[Cal Klaters were: Flo Ridan (Charles G. Edson), H. Francis Finch and Julian Hinds. Guest Professors Othernut and Doe are J. Charles Rathbun and Marvin A. Larson.]

Materials Found Major Cost in Water and Sewer Works

Materials constitute approximately 40 to 50 percent and labor slightly more than 30 percent of the cost of building new water and sewer systems, according to a joint survey conducted by the Labor Department's Bureau of Labor Statistics and the Public Health Service. Engineers' reports on 200 projects built in 1948, 1949, and 1950 provide the basis for a distribution of expenditures per million construction dollars, for the labor, materials, and supplies needed to build these projects, and for overhead, profit, and equipment charges.

Materials accounted for half the total expenditures for building new water works, in the same proportion for both treatment plants and distribution lines. One-fifth of all outlays for water-treatment plants went for key metal products (chiefly pipe and fittings) and reinforcing steel. Though material costs for new sewer works were somewhat less than for water-supply systems, amounting to about two-fifths of total outlays, labor costs were about the same—slightly over 30 percent. The sewage-disposal systems involved much less expenditure for the currently critical metal products and much more for cement, clay, and stone products.

Top Engineering Posts Are Open in San Diego

Forthcoming examinations for the positions of Public Works Director and Chief Inspector of Buildings for the City of San Diego are announced by Raymond Krah, personnel director for the city. Salaries range from $866 to $1,052 a month for the post of Public Works Director, and from $679 to $825 for Chief Building Inspector.

Written applications to take the examinations must reach the Civil Service Office, Room 453, Civic Center, San Diego, Calif., by 4:30 p.m., September 14, 1951. The applications must give full details of training and experience and may include exhibits of plans or programs, which the applicant has personally developed or directed. Proof of United States citizenship and a transcript or other evidence of the applicant's engineering school record will be required before final selection is made.

National Water Policy Studied at AWWA Meeting

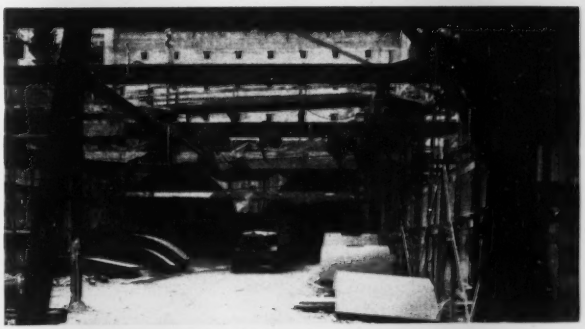
Discussion of the National Water Policy constituted a highlight of the recent 71st annual meeting of the American Water Works Association held in Miami, Fla. The findings of the President's Water Resources Policy Commission, recently made available to the public in a three volume report, were reviewed in a general session devoted to the subject by Samuel B. Morris, M. ASCE, member of the Commission.

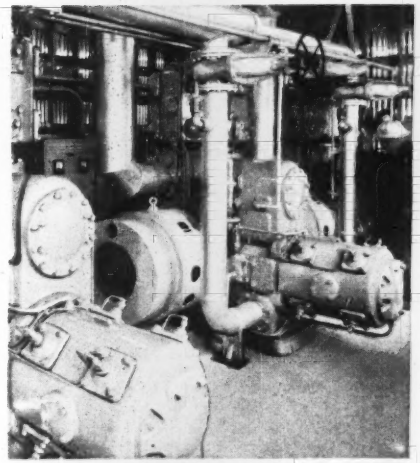
The report of the President's Commission was criticized as "at variance with sound engineering practice" by Abel Wolman, M. ASCE, who spoke in the dual capacity of chairman of the Coordinating Committee of the Engineers Joint Council Water Panel and chairman of the AWWA Committee on Water Policy. What the objectives of a sound National Water Policy should be were discussed by Malcolm Pirnie, Past-President ASCE and consulting engineer of New York City. He emphasized that water is the one natural resource that cannot be preserved by reduced use, and endorsed stream basin compacts as "the highest level for determination of the need for water projects and economic considerations."

The many sessions constituting the largest convention in the history of the organization included a program on "Water Supply Development in Latin America." In this session engineers from Chile, Cuba, Mexico, Puerto Rico, and Venezuela presented papers on water projects and problems south of the border. During a session of the Water Resources Division, Miami's principal problem of salt-water intrusion was discussed in a paper of much local interest by G. G. Parker, senior geologist, USGS.

AWWA officers for the coming year are A. E. Berry, president; Charles H. Carpenter, M. ASCE, vice-president; Harry E. Jordan, Affiliate ASCE, secretary; and William W. Brush, M. ASCE, treasurer.

San Francisco's new twin-bore tunnel will be 3400 ft long portal-to-portal with a 1600-ft enclosed bore. Air for the construction tools and equipment is distributed from a central source under 100-lb pressure through 6-in. pipe.





A G-E 150-hp 440-volt, 600-rpm synchronous motor drives each of the three 930-cfm Ingersoll-Rand compressors. Motors and compressors run 24 hours a day, five days a week.

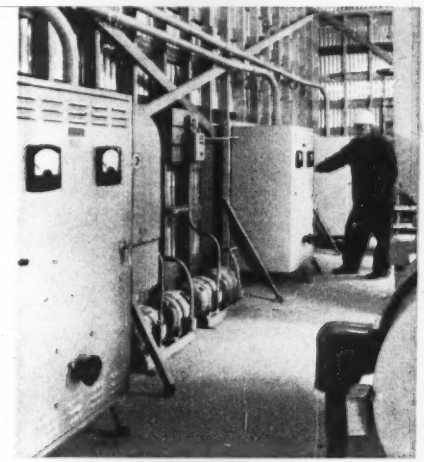
AIR for BOTH TUNNELER AND TRAVELER ... Electrically

G-E motors and control drive compressors for construction equipment and permanent ventilating blowers at San Francisco's Broadway Tunnel

Compressed air to operate the more than 100 tools, hoists, and muckers being used by the Morrison-Knudsen Construction Co. in work on San Francisco's Broadway tunnel is supplied by centrally located compressors driven by G-E motors and control. Used in place of numerous individual units, the central air supply cuts maintenance costs and adds flexibility to the tunneling operation.

Expressing complete satisfaction with the system, Assistant Project Manager Harry Kirmond reports outstanding performance from G-E drives: *no unscheduled downtime has been charged to the drives up to the halfway mark in the two-year project.* And when the tunnel is complete, G-E equipment will still be on the job in the form of ventilating-equipment drives, and complete distribution facilities for lighting.

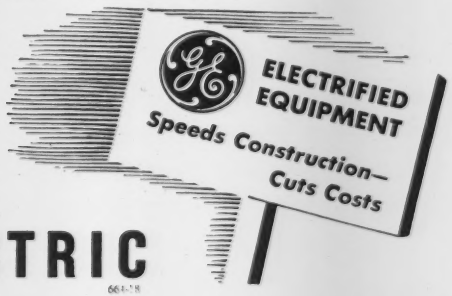
This is another excellent example of the flexibility, speed, and economy that G-E electrification can give you on construction jobs. *General Electric Company, Schenectady 5, N. Y.*



G-E control for each motor consists of a semi-magnetic starter providing reduced-voltage starting and complete motor protection. G-E motor-generator sets supplying field current are controlled by G-E magnetic starters mounted above them.

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.



GENERAL ELECTRIC

66-118

NEW IN EDUCATION

A contract for research on multi-story apartment building construction has been awarded to Illinois Institute of Technology by the Housing and Home Finance Agency, according to a joint announcement from the two organizations. An immediate objective of the project is the development of building methods that will make possible the construction of multi-family dwellings at savings in costs and in the use of manpower and critical materials through the adaptation and application of advanced developments in materials, use of space, structural and mechanical design, assembly and installation of equipment. The work will be done by the Institute's civil engineering department under the direction of Elmer I. Fiesenheiser, M. ASCE, associate professor of civil engineering.

Establishment of a $2,500 scholarship fund for outstanding engineering seniors at Rutgers University is announced jointly today by the university and the New Jersey Utilities Association. In order to qualify for the utilities scholarship, which carries an annual stipend of $500 a year, the nominee must be a resident of New Jersey, and have received his secondary schooling in the state, have an outstanding scholastic record during his first five semesters at Rutgers, and must show promise of worthwhile achievement. Fifty-four public utilities in New Jersey form the New Jersey Utilities Association, which was established in 1916.

Graduate and undergraduate evening courses in engineering will be offered this fall by the City College of New York. One group of courses will offer review and preparation for the New York State Professional Engineer's License Examination. Subjects to be covered include structural planning and design, general engineering and engineering economics. Courses in building construction will cover plan reading and estimating, elementary structural design, architectural drawing, applied building construction design, use of surveying instruments, construction and superintendence, and air conditioning. Descriptive folders may be obtained from Prof. W. L. Willig, City College School of Technology, New York City 31.

On October 6 Norwich University will celebrate the 100th anniversary of the graduation of Maj. Gen. Grenville Mellen Dodge, Honorary Member of ASCE and pioneer in the building and development of some 34 railroads west of the Mississippi. A central feature of the celebration, which will also commemorate completion of 132 years of civil engineering teaching at Norwich, will be a railroad pageant.

To help provide trained personnel in the field of sanitation, Ohio State University will initiate a new curriculum in sanitary engineering, starting this autumn. Developed as an option in civil engineering, the course will lead to a bachelor's degree in that field, or to the combined bachelor of civil engineering and master of science degrees upon completion of five years of study. Among the specialized courses, which begin in the third year, are sanitary bacteriology, environmental sanitation, advanced hydraulics, water- and sewage-treatment plant design, and industrial waste treatment. A recently completed sanitary engineering laboratory will serve as the workshop for students and faculty members interested in special problems and research in the field of sanitation.

A plan for liberal education in engineering has been announced by the colleges of liberal arts at the University of Mississippi and Millsaps College, and the university School of Engineering. A student interested in engineering will have the opportunity to study three years at one of the cooperating liberal arts colleges and two years at the School of Engineering. Completion of the five-year program will result in appropriate bachelor's degrees from both institutions.

A two-month training program in topographic mapping, conducted by the U.S. Geological Survey at Clemson College, has come to an end with 36 men receiving degrees. The course, first of its kind, featured intensive instruction in field work for map-making processes.

Dedication of a new laboratory and office building of the State Water Survey Division of the Illinois Department of Registration and Education will take place on the campus of the University of Illinois, October 1 through 3. At this time a conference on water resources, embracing hydrology, treatment, and radar-weather relationships, will be held. Address inquiries to the Dedication Conference Chairman, State Water Survey, Box 232, Urbana, Ill.

Ohio State University recently established an Institute of Geodesy, Photogrammetry and Cartography. Organized specifically to give an integrated program of undergraduate and graduate instruction in the field, and to initiate and encourage research at the graduate and professional levels, the curriculum is being offered to qualified students at the beginning of the autumn quarter, October 2, 1951. Further information can be obtained from the Executive Director, Institute of Geodesy, Photogrammetry and Cartography, Ohio State University, 309 Administration Building, Columbus 10, Ohio.

Southern industrial development will be greatly assisted with an expanded program of graduate instruction in fluid mechanics and hydraulic engineering that will start in September 1951 at the Georgia Institute of Technology, according to an announcement from Prof. R. E. Stiemke, Assoc. M. ASCE, director of the School of Civil Engineering. Those completing the new course will be awarded the degree of Master of Science in Civil Engineering. Prof. C. E. Kindsvater, Assoc. M. ASCE, will be in charge of the expanded graduate training and research activities.

The Army Corps of Engineers has contracted with the Kansas State College Engineering Experiment Station for a study of metal mats for landing fields. The research, to be done specifically for the Waterways Experiment Station of the Corps, Vicksburg, Miss., is a continuation of work being carried on at the college Experiment Station for the past few years. Important technical advances in design of pavements for airports have already resulted from the research. The new work will be directed by Dr. Gerald Pickett of the department of applied mechanics with the cooperation of Prof. Charles Scholer, department head.

Annual Convention of ASCE
Hotel Statler, October 22-26, 1951

(*Please Print*)

Name .....

Street .....

City ..... Zone ..... State .....

MAIL TO:
Mr. John F. Fenchen
Sales Manager
Hotel Statler
Seventh Ave. & 32 St.
New York, N. Y.

Please reserve for my occupancy the following hotel accommodation:

Double ..... Single .....

Double—twin beds ..... Suite .....

Other .....

Date and hour of arrival .....

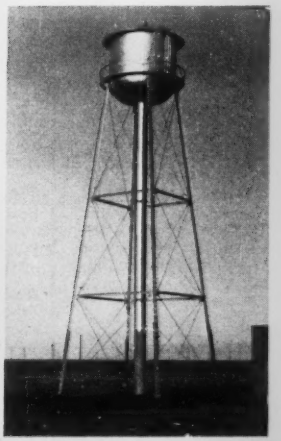
Date of departure .....

FOR *Essential*
PLANT PROTECTION

PITTSBURGH • DES MOINES

ELEVATED STEEL TANKS

An ever-ready supply of water at dependable pressure contributes greatly to plant security. When a modern Pittsburgh-Des Moines Elevated Steel Tank stands guard over your plant, fire protection problems are lessened, lower insurance rates are gained, better water service is a continual benefit. *Write for our latest 20-page Elevated Tank Brochure.*



PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25)	3470 Neville Island	DES MOINES (8)	971 Tuttle Street
NEW YORK (7)	Room 951, 270 Broadway	DALLAS (1)	1275 Praetorian Bldg.
CHICAGO (3)	1274 First National Bank Bldg.	SEATTLE	978 Lane Street
	SANTA CLARA, CAL.	677 Alviso Road	

DECEASED

Former Society Director, Richard S. Buck, Dies

Richard Sutton Buck (M. '98) former ASCE Director and retired civil engineer and bridge authority of Washington, D.C., died on August 1, at the age of 86. As chief engineer of the New York City Department of Bridges, Mr. Buck designed the Manhattan Bridge and played an important role in the design of the Williamsburg and Queensboro bridges. He also designed and supervised construction of the Queenston Suspension Highway Arch and the Grand Trunk Railway Arch bridges connecting Canada and the United States over the Niagara River, receiving the Society's Thomas Fitch Rowland Prize for his paper on the design of the Grand Trunk Bridge. As a partner in the New York City firm of Sanderson & Porter, he served as general manager of construction for the original Stanislaus River Power Development in California from 1907 to 1912. He was a major in World War I, receiving the British D.S.O. for his services. Mr. Buck had lived in Washington since 1933, when he was appointed to the technical board of review for PWA projects. He was a graduate of Rensselaer Polytechnic Institute.

Richard S. Buck

Former ASCE Officer, James L. Ferebee, Dies

James Lumsden Ferebee (M. '19) consulting engineer of Pinehurst, N.C., died there on August 5, at the age of 70. He was a graduate of North Carolina State College. Early in his career Mr. Ferebee was employed as assistant engineer for the Durham & Charlotte Railroad; assistant city engineer for Wilmington, Del.; and engineer for Atlantic City, N.J. Subsequently, he became principal assistant engineer for the Milwaukee and Metropolitan Sewerage Commissions; commissioner of public works for West Allis, Wis.; and chief engineer and general manager of the Sewerage Commission of Milwaukee. Of recent years he had practiced engineering at Pinehurst, N.C. Active in Society affairs, Mr. Ferebee served as Director from 1936 to 1938 and Vice-President, in 1939 and 1940.

James L. Ferebee

Richard Hamilton Boyles (M. '40) manager for the Fox Chapel Authority, at Pittsburgh, Pa., died recently. He was 49. Upon his graduation from Tri-State College in 1924, Mr. Boyles entered the employ of the Edeburn-Cooper Co. He then worked for various industrial firms and planning and highway departments in New York and Pennsylvania. In 1937 he joined the Fox Chapel Authority, for which he constructed 38 miles of water mains, a filter plant, and other improvements.

William Cantrell Curd (M. '17) since 1947 engineer and railroad specialist for the Chicago Plan Commission, Chicago, Ill., died there on July 20. His age was 71. From 1943 to 1945 Mr. Curd was in charge of the New York office of the American Association of Railroads. Earlier he had been vice-president of the Briggs Construction Co., of Akron, Ohio, and for several years was with the Missouri Pacific Railroad in St. Louis. He was a Purdue University graduate.

Elmer Newton Dunn (Assoc. M. '47) division construction engineer for the Montana State Highway Department, at Lewistown, Mont., died there on May 9, at the age of 45. With the exception of three years (1942-1945) as engineer for the contracting firm of Peter Kiewit Sons' Co., at Sheridan, Wyo., Mr. Dunn had spent his career with the Montana Highway Department in various engineering capacities.

William Earle Elam (M. '17) chief engineer for the Board of Mississippi Levee Commissioners, at Greenville, Miss., died on June 16. He was 68. Mr. Elam was engaged by the Mississippi Levee Board for 45 years, serving as chief engineer from 1946 until the time of his death. He suggested the "cut-off plan" of flood control for the Mississippi River. In 1938 he was president of the Mid-South Section of the Society. He received his training at the University of Texas.

Ellis Alexander Frink (M. '01) retired civil engineer of Washington, D.C., died there on July 11, at the age of 89. Mr Frink had been bridge engineer and principal assistant engineer for the Seaboard Air Line Railway Co., at Portsmouth and Norfolk, Va., for over 40 years, retiring in 1938. Earlier he was engaged as chief engineer and general manager by the Structural Iron Co., of Baltimore, Md., and practiced engineering under the name of Frink & Hazen.

Elmer Woodson Hopkins (M. '39) since 1946 sanitary engineer for the Mission Township Main Sewer District of Johnson County, Kansas, died on June 29. His age was 58. Before going to Kansas in 1923, Mr. Hopkins was engineer for Henderson County, Kentucky. He was connected with Black & Veatch from 1923 to 1936, and later was city engineer for Salina, Kans. He was educated at the University of Kentucky.

William Coyt Jackson (Assoc. M. '42) partner in the Tucumcari Engineering Co.

FOR YEARBOOK DATA. Please supply *all* information requested.

ASCE MAIL AND BUSINESS ADDRESS RECORD

DO NOT WRITE IN THIS SPACE

Name ..... (Last Name) (Please Print) (First Name) (Middle Name)

Title or Position ..... (Please Print or Type All Information)

Name of Firm or Organization .....

Business Address ..... (Street) (City) (State)

Residence Address ..... (Street) (City) (State)

Send Mail and Publications to: Business Address ☐ **Residence Address** ☐

Nature of Firm's Business ..... (Product, Business or Service (Not for Publication))

Signature ..... **Date** .....

ABC

OLD L.S.

NEW L.S.

T.D.

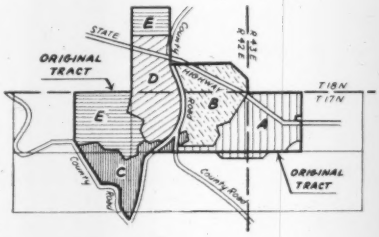
N.C.

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

How to Please the Ladies



"Surveying country subdivided into townships, ranges and sections seems, on first thought, to offer few problems," writes F. W. Welch of Pullman, Wash. "But this rectangular system, ideal for prairie states, does not lend itself to the rolling hills of 'the Inland Empire'—the wheat and pea belts of eastern Washington State."

"Here, to approximate contour farming, farmers have traded land back and forth, eliminating steep slopes and hard pulls. As a rule, no records are kept, causing problems when old-timers pass on. Heirs usually specify that a tract be divided to 'farm right'—meaning lines must run up valleys, over saddles between hills, and provide a spring and building site for each.

"Recently I had to divide 1,000 acres among five girls in this manner. The land lay in four townships, two ranges and six sections; was cut by a state highway and four county roads. The highway and one road had been relocated; and there were two unrecorded property exchanges for convenience in farming.

"I tackled the job with a Gurley Solar Transit (the new Land Office type). Distances were measured by slope chaining with 300-ft. tape and Abney level, and reduced to horizontal by use of a versine table. Directions were read by true azimuths, using the backsight method, with solar checks every three or four setups.

"We discovered that original surveys were made with a solar out of adjustment. While Government notes read, 'Thence I run due north,' the line was actually N. 3°50'E. A mile, measured by steel tape, never agreed with one measured way back in 1878 with a worn-out Gunter's chain.

"Outer boundaries were run, Lats and Deps and D.M.D.'s computed, and area plotted. Trial division lines were then run and acres computed. *Result:* Each girl received 200 acres ± maximum of ½ acre... *Everybody satisfied.*"

Pleasing the Surveyor

"A lot of the credit goes to the Gurley Transit," says Fred Welch, Asst. Prof., Civil Engineering (Ret.), State College of Washington. "My Gurley, purchased four years ago, is still in perfect adjustment."

You, too, will find the Gurley Transit an accurate aid. Bulletin 50 gives all details.

We would like to publish one of your field experiences on this page. Send us your idea—we'll contact you later for details.

W. & L. E. GURLEY, 518 FULTON STREET, TROY, N. Y.

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments, Meteorological Instruments.

GURLEY

Surveying and Scientific Instrument Makers Since 1845

A must for construction men!

Increase your profits and eliminate losses by controlling costs. Today's cost-conscious contractor and engineer, small operator or large, will find this comprehensive handbook provides the answers to construction accounting and cost control problems common to all. Prepared under the auspices of the American Society of Civil Engineers, it is written by men who are active in and really know construction.

Howard P. Marton, Sec. & Asst. Treas., Raymond Concrete Pile Co.

Arnold O. Babb, Asst. Director, Programs and Finance, U.S. Bureau of Reclamation.

Donald J. Leitch, Office Manager, Mount Morris Dam Builders.

Well illustrated and supported by charts and specimen accounting forms, this authoritative 97-page, 8½ by 11, sturdily bound book covers the complete cycle of estimating, accounting, distributing and analyzing of all operational and overhead costs. A practical and easily applied system is fully outlined. Included are sections on:

PRELIMINARY ESTIMATING
BUDGETING
CLASSIFICATION OF CONSTRUCTION COST ACCOUNTS
DISTRIBUTION OF COSTS
CONTROL OF COSTS
TIME AND MOTION STUDIES
FINANCING AND TAX PROBLEMS

Off the press August 1st

Sent postpaid to ASCE Members—$4.00
To non-members—$5.00
To ASCE Student Chapters in quantities of 10 or more—$3.00 each.
To colleges for textbook use in quantities of 10 or more—$3.00 each.

AMERICAN SOCIETY OF CIVIL ENGINEERS
33 West 39th St., New York 18, N.Y.

American Society of Civil Engineers
33 West 39th St., New York 18, N.Y.

Please send ..... copies of "CONSTRUCTION COST CONTROL."
Enclosed is check (or money order) in the amount of $ .....
(I am) ..... (I am not) ..... a member of ASCE.

Name .....
Firm .....
Street .....
City ..... State .....

Tucumcari, N. Mex., died on February 20, 1949, though notice of his death has just reached Society Headquarters. He was 41 and a graduate of New Mexico A. & M. State College. Earlier in his career Mr. Jackson had worked for the city engineer of Portales, N. Mex.; the Shell Geophysical Survey Party, at Portales; and the Texas and New Mexico state highway departments.

Herbert Tolfree Knapp (M. '47) head of his own engineering concern in Memphis, Tenn., died on April 12. He was 38. Mr. Knapp had been junior engineer in the public works department at the U.S. Navy Yard, Portsmouth, N.H.; graduate research assistant on the Joint Highway Research Project at Purdue University; field engineer for the Dravo Corp., at Pittsburgh, Pa.; and instructor in civil engineering at Purdue. From 1943 to 1946 he served as an officer in the U.S. Navy Civil Engineer Corps. He then became engineer for the Weston Corp., and a short time later established the firm of Herbert T. Knapp & Associates, Engineers. He received his degrees from New Hampshire and Purdue universities.

Robert Walker Lemen (Assoc. M. '12) since 1931 president of Oregon Motor Stages, at Portland, Oreg., died on January 2, at the age of 70. At the start of his career Mr. Lemen was engaged by the Baltimore & Ohio and the Antofagasta, Chile & Bolivia railways. He later worked for various stage lines in Washington, California, and Oregon.

William Jacob Mozart (M. '11) retired engineer of Los Angeles, Calif., died on July 26, at the age of 96. A specialist in river and harbor work, hydraulic power plant construction, and railroad engineering, Mr. Mozart acted as engineer and consultant to many organizations in the United States, Mexico, and foreign countries, including the Ambursen Construction Co., the Chihuahua & Pacific Railway, and Cebu, P. I.

Don Hull McCreery (M. '43) director of engineering for Holmes & Narver, Inc., of Los Angeles, Calif., died suddenly in June. He was 51. Mr. McCreery had been connected with Quinton Engineers, Ltd. for several years and until recently was president of the concern. Prior to that he was senior office engineer and chief engineer for Leeds, Hill, Barnard & Jewett. He also engaged in private practice. Active in the affairs of the Society's Los Angeles Section, he served as treasurer (1938-1939), vice-president (1941), and president (1944), and was chairman of various Section committees, including the Program Committee. He received his training at the Massachusetts Institute of Technology.

Don Hull McCreery

Daniel Willets Overocker (Assoc. M. '12) for a number of years contractor with

NEEDS ONLY ONE KIND OF LUBRICANT!

another good reason for choosing

THE GARDNER-DENVER VP4 Sump Pump

You don't grease a Gardner-Denver VP4 Sump Pump. Only a *single* kind of lubricant is required. One filling of oil lubricates every moving part — lasts for 24 operating hours — saves your greaser's time — minimizes the chances for lubrication neglect.

The VP4 solves other "Mud Puddle" problems for you, too —

Gardner-Denver VP4 Sump Pump dewatering a tunnel under construction.

It won't bury itself in a muddy sump . . . can't suck grit and water into the motor or bearings. An automatic governor idles pump when suction runs dry — saves air and wear. Easy to handle . . . compact, lightweight.

For complete specifications, write today for Bulletin VP4.

SINCE 1859

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., Toronto, Ontario

JOHNSTON

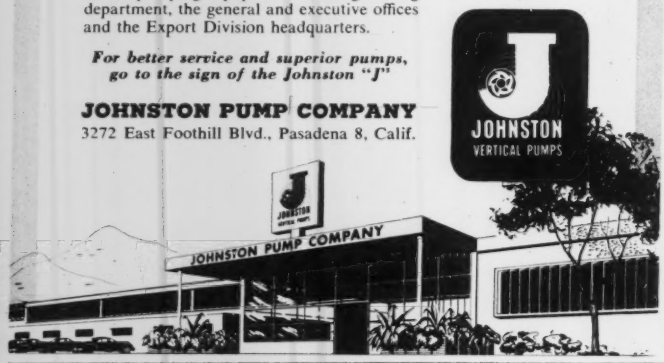
answers customer demand

The Johnston Pump Company is instilled with the old-fashioned ideal that a successful firm should do a better job today than it did yesterday. Johnston's new and modern factory in Pasadena, California, is tangible evidence of faith in this policy and a positive answer to the ever-increasing demand for Johnston products by pump buyers the world over.

Plant facilities include a pump testing laboratory equipped with the latest instruments, complete shops for manufacturing precision pumping equipment, the engineering department, the general and executive offices and the Export Division headquarters.

For better service and superior pumps, go to the sign of the Johnston "J"

JOHNSTON PUMP COMPANY
3272 East Foothill Blvd., Pasadena 8, Calif.



When You Call For Any Industrial Requirement In Piping

ALBERT

"Rings the Bell"

***SPEEDLAY PIPE SYSTEM*—completely packaged for fast-laying temporary and semi-permanent lines for water, compressed air and other services.**

PILING—Sheet Piling—light weight • Tubular—all sizes

PILE SHELLS—Spiral Welded, Hel-Cor, Riveted, CAISSONS

PILE FITTINGS—All types and sizes for steel and wood, cast steel and iron points. Plates and shoes cast steel and malleable iron sleeves.

CULVERTS—Corrugated, Spiral or Riveted Steel.

VALVES AND FITTINGS—Tube turns, Dresser, Vitaulic, cast iron or steel, forged steel, special alloys, water main.

SPECIALISTS IN PRE-FABRICATED PIPING

ALBERT
PIPE SUPPLY CO., INC.
Berry at North 13th St.
Brooklyn 11, N. Y.
Phone EVergreen 7-8100

offices in Burlington, Vt., died there some time in May. He was 67. Mr. Overocker's experience included work as assistant engineer for G. H. Gifford; engineer-draftsman on the New York State Barge Canal Project; and assistant engineer in the Office of the New York State Engineer. Later he engaged in contracting. He received his training at Rensselaer Polytechnic Institute.

Dean Peabody, Jr. (M. '35) professor of architecture in the Harvard University Graduate School of Design, died on August 7, at the age of 63. He was graduated from Massachusetts Institute of Technology in 1910 and was a member of its faculty for more than 35 years. In 1946 he became visiting lecturer at Harvard and in 1947 professor of architecture. A pioneer in concrete for buildings, he was author of *Design of Reinforced Concrete Structures*.

Roland Decker Pierson (M. '51) regional engineer for the Atchison, Topeka & Santa Fe Railway Co., at Los Angeles, Calif., died on May 29. His age was 63. Except for a two-year period in service with the U.S. Army Engineers, Mr. Pierson had been connected with the A.T. & S.F. Railway for nearly 40 years, becoming regional engineer in 1942.

Gerald Francis Ramirez (Assoc. M. '45) structural designer for Burns & Roe, Inc., New York, N.Y., died on November 30, 1950, according to word recently received at Headquarters. He was 46 and a graduate of the College of the City of New York. Mr. Ramirez had been with George Beckwith, contractor of Gilroy, Calif., the Brooklyn Bureau of Sewers, the Army Corps of Engineers, and the Otis Elevator Co.

Alvin Christian Rasmussen (M. '22) consulting engineer of Indianapolis, Ind., died there on June 13. His age was 61. Mr. Rasmussen began his career with the James W. Insley Manufacturing Co., serving successively as draftsman, chief draftsman, chief engineer, and vice-president. Then he became a major in the Ordnance Reserve of the Army, retiring with the rank of colonel in 1946. At that time he established his consulting practice. He was educated at Rose Polytechnic Institute.

Henry George Reitz (M. '19) engineer of Cleveland, Ohio, died on July 6, at the age of 68. From 1906 to 1917 Mr. Reitz was associated with the city of Cleveland in various capacities. He then became city engineer of West Park, Ohio, and later president of the Henry G. Reitz Engineering Co. He received his degrees from the Case School of Applied Science.

Paul Schultze (M. '01) for several years special representative for the Nazareth Cement Co. in New York City, died on May 11, at the age of 65. Mr. Schultze had been engineer for Utica, and Oneida County, New York, and city engineer of Troy, N.Y. In 1915 he became Deputy State Highway Commissioner of New York, serving in that capacity for about 20 years. He was a Rensselaer Polytechnic Institute graduate.

Mortimer Wilson Smith, Jr. (M. '47) engineer for the State Public Service Commis-

sion, at Charleston, W. Va., died on April 10. He was 60. In recent years Mr. Smith served as chief engineer for the State Road Commission of West Virginia, a member of the state legislature, and engaged in private practice. He was a graduate of the University of Virginia.

Archibald McClure Strong (Assoc. M. '08) Los Angeles, Calif., consultant, died on July 14, at the age of 75. Mr. Strong practiced hydraulic and mining engineering in Los Angeles for over 40 years. From 1904 to 1910 he was city engineer for Bishop, Calif., and earlier was surveyor for several counties in California. He graduated from Stanford University.

William Garnett Waggener (Jun. M. '47) engineer for the Phillips Petroleum Co., at Old Ocean, Tex., died on March 31. He was 28. Mr. Waggener received his civil engineering degree from the Texas A. & M. College.

Bertrand Hinman Wait (M. '18) president of the Wait Associates, Inc., New York City, died at his home in New Rochelle, N.Y., on July 20, at the age of 71. Mr. Wait organized his own engineering firm in 1935 and had specialized in highway and building construction. Before that he was eastern manager for the Portland Cement Association and district engineer for the New York State Department of Public Works. He graduated from Cornell University.

Edward Beaumont Wardle (M. '10) since 1945 consulting engineer for the Consolidated Paper Corp., Ltd., of Montreal, Canada, died at his home in Meriden, Conn., on July 11, at the age of 77. Upon his graduation from Dartmouth College in 1889, Mr. Wardle entered the employ of Tower & Wallace of New York City. He worked for Geo. F. Hardy, consulting engineer of New York from 1902 to 1914, and was chief engineer for the Laurentide Co.

Meetings and Conferences

American Institute of Chemical Engineers. Technical sessions, inspection trips, and social events are scheduled for the American Institute of Chemical Engineers meeting at the Sheraton Hotel, in Rochester, N.Y., September 16–19.

American Public Works Association. Civil defense and safety affecting public works will be discussed at the public works congress and equipment show, sponsored by the American Public Works Association, in the Veterans' Memorial Building, Detroit, Mich., September 16–19.

American Society of Mechanical Engineers. The fall meeting of the American Society of Mechanical Engineers will take place at the Hotel Radisson, in Minneapolis, Minn., September 26–28.

American Society of Sanitary Engineering. The 45th annual meeting of the American Society of Sanitary Engineering will be held at the Hotel Statler in Detroit, Mich., September 16–21.

Building Research Congress. Progress in the building research field will be reviewed during the Building Research Congress of the Institute of Civil Engineers in London, England, September 11–20.

can old age "cripple" your important drawings?

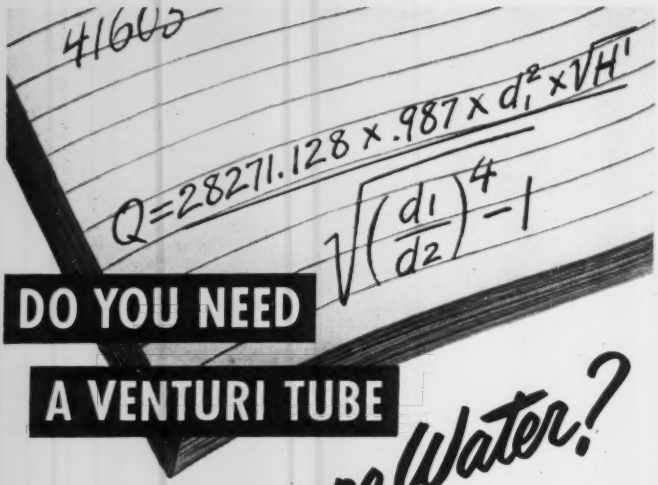
Not if you put them on Arkwright Tracing Cloth. Arkwright Cloth is the best insurance you can get that your drawings will never become brittle or opaque with age — never get paper-frayed around the edges to spoil your work.

Arkwright's extra quality shows right from the start. You can re-ink clean, razor-sharp lines on Arkwright Tracing Cloth over the heaviest erasures without feathering or "blobbing". And you can get clean, clear blueprints — if you need to — for years and years to come.

All good reasons for you to remember: if a drawing is worth saving, put it on Arkwright Tracing Cloth. Write for samples now to Arkwright Finishing Co., Industrial Trust Bldg., Providence, R. I.

ARKWRIGHT
Tracing Cloths

AMERICA'S STANDARD FOR OVER 30 YEARS



DO YOU NEED A VENTURI TUBE to measure Water?

1. An 18'-6" diameter bronze main belt and a 12'-0" diameter bronze throat belt for use in a concrete Venturi Tube.

2. 72" diameter plate steel reverse flow Venturi Tube.

3. 96" diameter Venturi Tube with plate steel upstream and recovery sections, cast iron throat section.

4. A 60" diameter all bronze Venturi nozzle.

IT'S SIMPLEX IT'S ACCURATE

SIMPLEX makes Venturi tubes for measuring tremendous volumes of water flowing through large diameter pipelines. They include a variety of designs and sizes to suit specific conditions such as those relating to pressure, volume, and space limitations.

Write, stating your particular needs, to Simplex Valve & Meter Company, Dept. 9, 6724 Upland St., Philadelphia 42, Pennsylvania.

SIMPLEX

VALVE AND METER COMPANY

Federation of Sewage and Industrial Waste Associations. The 24th annual meeting of the Federation of Sewage and Industrial Wastes Associations is scheduled for St. Paul, Minn., October 8–11.

Forest Products Research Society. The Midwest section meeting of the Forest Products Research Society will take place at Oshkosh, Wis., September 19–21.

Instrument Society of America. Latest advances in instruments will be discussed at the sixth annual conference and exhibit of the Instrument Society of America in the Sam Houston Coliseum, Houston, Tex., September 10–14.

Institute of Traffic Engineers. The 22nd convention of the Institute of Traffic Engineers is scheduled for Los Angeles, Calif., September 23–27.

National Safety Congress and Exposition. The 39th National Safety Congress and Exposition is to be held in Chicago, Ill., October 8–12.

Pacific Coast Building Officials Conference. Headquarters for the Pacific Coast Building Officials Conference will be the Hotel Utah, Salt Lake City, Utah, September 18–21.

Second Conference on Industrial Experimentation. Sponsored by the Department of Industrial Engineering of Columbia University, the Second Conference on Industrial Experimentation will be held on the campus from September 17–21.

World Metallurgical Congress. Conservation and utilization of metal resources will be the topics of discussion at the World Metallurgical Congress, which will be conducted by the American Society for Metals in Detroit, Mich., October 14–19.

NEWS OF ENGINEERS

Joseph I. Gurfein, air officer for the G-3 (plans and operations) section of the X Corps in Korea, has been elevated to the rank of lieutenant colonel in recognition of his "outstanding performance of duty with the X Corps since the Inchon invasion last September." Colonel Gurfein coordinates the air support of the X Corps' ground units along the central Korean front.

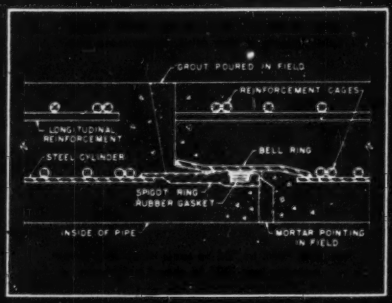
E. D. Dryfoose, previously engineer of road plans for the Illinois State Division of Highways, at Springfield, has been made traveling engineer in the Bureau of Design.

David S. Winick is now employed in the engineering department of the Parco Design Corp., with offices in New York City. Formerly he was associated with the Neversink Division of the New York City Board of Water Supply and Consultants & Designers, Inc., of New York.

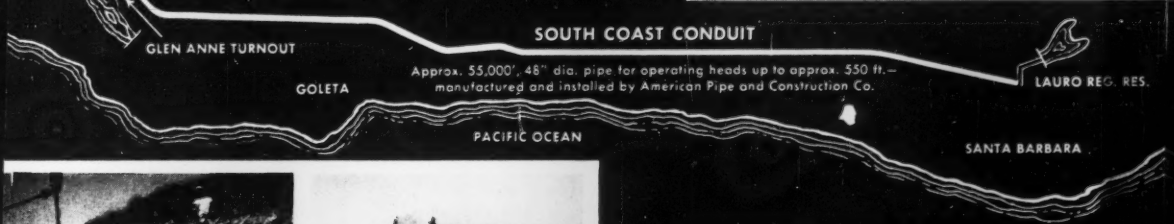
E. I. Fiesenheiser has been promoted from the position of associate professor of civil engineering at Illinois Institute of Technology to the rank of professor.

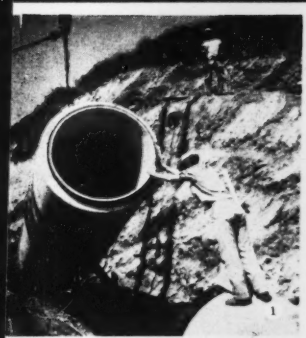
Albert J. Ryan, lieutenant colonel, Corps of Engineers, Department of the Army, has been made commanding officer of the 307th Airborne Engineer Battalion, 82nd Airborne Division. Previously Colonel Ryan was executive officer for the battalion.

Rough, Tough and Rugged!



Trenching was no ordinary problem with slopes as steep as 73 percent. High line designed by company engineers carried 9½-ton pipe sections to most difficult placements.


TECOLOTE TUNNEL
GLEN ANNE TURNOUT
SOUTH COAST CONDUIT
Approx. 55,000', 48" dia. pipe for operating heads up to approx. 550 ft.—manufactured and installed by American Pipe and Construction Co.
GOLETA
LAURO REG. RES.
PACIFIC OCEAN
SANTA BARBARA



1. Pipe laying was simplified to the maximum extent possible by use of Lock Joint Rubber Gasket Joints.

2. This 80 ft. deep cut was backfilled to a depth of 20 feet over the pipe. Lock Joint Pressure Pipe will sustain enormous external loads.

3. Entire line was engineered to go together piece by piece, including all fittings and specials, a characteristic advantage of Lock Joint Pressure Pipe.

Few, if any, main water supply lines have presented more difficult construction problems than the South Coast Conduit of the Cachuma Water Project. Spanning the mountains and valleys of the precipitous terrain between Tecolote Tunnel and the Santa Barbara area, the line was considered one of the toughest projects of this kind since the construction of the San Diego Aqueduct, which also used Lock Joint Reinforced Concrete Pressure Pipe. Now nearly completed, modern engineering and the superior qualities of Lock Joint Concrete Cylinder Pipe have helped make it practicable. Illustrations indicate some of the ways this versatile pipe met the needs of this rough, tough, rugged job.

This line is a brilliant example of permanent reinforced concrete pipe line construction. It will serve the Santa Barbara area for generations at peak performance and minimum maintenance expense. The same advantages are available to you for your project—advantages that mean reductions in the cost of delivered water.

A PIPE AND CONSTRUCTION CO.

Concrete Pipe for Main Water Supply Lines, Storm and Sanitary Sewers, Subaqueous Pipe Lines

P.O. Box 3428, Terminal Annex, Los Angeles 54, California

OAKLAND—SAN DIEGO—PORTLAND, OREGON

NEED TO HANDLE LARGE QUANTITIES OF SAND AND GRAVEL AT LOW COST?

CONSULT YUBA on the feasibility of using bucket-ladder dredges to move sand and gravel. More than 40 years of experience proves that bucket-ladder dredges can move big yardages at remarkably low costs. Two case histories show the redesigning and rebuilding possibilities . . .

CONSTRUCTS DIVERSION CHANNEL

YCGF No. 16, built by YUBA in 1916 with 18 cu. ft. buckets and 77 ft. digging depth, later was equipped with two stacker ladders to pile tailings in parallel rows about 500 ft. apart, forming diversion channels for flood control while dredging alluvial gravel. In 1930, YCGF No. 16 was redesigned, moved to Folsom, Calif. and rebuilt as Capital No. 3 for 62½ ft. digging depth.

REBUILT 3 TIMES

Capital No. 2 (later Biggs No. 2), built in 1906 as YCGF No. 3, has been redesigned and rebuilt 3 times and used in three different areas with digging depths changed as needed from 60 feet to 50 feet, then to 47 feet below water. Bucket speed was increased from 18.6 to 22.8 feet per minute; bucket capacity increased from 7 to 9 cu. ft., and daily average running time upped from 18.3 to 22.1 hours.

Use bucket-ladder dredges for such jobs as these: changing stream channels, constructing levees, cofferdams or canals; digging deep ground, clay, boulders or bedrock; handling sand and gravel.

Let YUBA help you work out any such problem. We will design and build a new dredge for you; help you find a used dredge; move, redesign and rebuild any dredge you now own, whether YUBA-built or not. Wire, write or call us—without obligation, of course.

YUBA DREDGES — PROVED DEPENDABILITY

YUBA MANUFACTURING CO.

Room 716, 351 California St., San Francisco 4, California, U. S. A.

AGENTS { SIME, DARBY & CO., LTD. · SINGAPORE, KUALA LUMPUR, PENANG. / SHAW DARBY & CO., LTD., 14 & 19 LEADENHALL ST., LONDON, E. C. 3.

CABLES: YUBAMAN, SAN FRANCISCO · SHAWDARCO, LONDON

Victor S. Fago, previously hydraulic engineer for the International Boundary and Water Commission, in San Diego, Calif., is now chief of the Engineering Branch of the Corps of Engineers, at the Rhine Military Post in Germany.

Howard J. Hansen, until recently head of the structures research department at the U.S. Naval Civil Engineering Laboratory, Port Hueneme, Calif., is now principal engineer for the New Orleans, La., consulting firm of G. H. Heft & Co.

Claude Inglis is now director of the Hydraulics Research Station of the Department of Scientific and Industrial Research, Hydraulics Research Organization, at Howbery Park, Wallingford, Berkshire, England.

Everett L. Clark, consulting engineer of Los Angeles, Calif., announces that his office has been moved from the Cairns Building to 1004 A. G. Bartlett Building, 215 West Seventh Street, of that city. He specializes in civil and hydraulic engineering.

William J. Homan has accepted appointment to the post of chief of the public works division in the public services department of the United States Civil Administration of the Ryukyus Islands. Since 1948 Mr. Homan has served as an Army civilian employee at the Okinawa Engineering District.

T. R. Smith, engineer for the U.S. Bureau of Reclamation, at Great Falls, Mont., has gone to Formosa to head irrigation activities under the ECA program there.

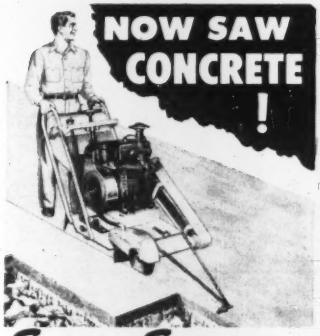
Walter E. Hanson is now bridge engineer for the Illinois State Highway Department, with headquarters at Springfield. Formerly he was associate professor of civil engineering at the University of Illinois.

Alfred T. Glassett, president of the W. J. Barney Corp., New York City, has been elected president of the Alumni Association of the Massachusetts Institute of Technology.

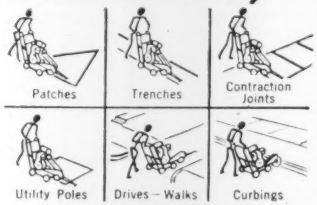
Morris M. Cohn was elected chairman of the New England Interstate Water Pollution Control Commission at its recent annual meeting in Chicopee, Mass. He is public health engineer of Schenectady, N. Y.

George F. Burch has resigned as engineer of bridge and traffic structures for the Illinois State Division of Highways, at Springfield, after 42 years of state service. **L. E. Philbrook,** assistant bridge engineer, has been named acting bridge engineer there.

D. M. Forester, construction engineer for the U.S. Bureau of Reclamation, at Lemmon, S. Dak., has been appointed district engineer for the Bureau's Yellowstone District. Formerly Mr. Forester was in charge of all power transmission line construction in South Dakota.



Save by Sawing...



with the
CLIPPER
CONCRETE SAWS

You save Time and Material when you cut straight, smooth edges with a Clipper Concrete Saw before breaking out for patches, trenches or machinery bases. Eliminate radial cracks—stop spalling! Imagine . . . Saw up to 12' per minute 1" deep in Limestone aggregate concrete!

Saw ¼ slab depth . . . then break out. Only a minimum of replacement material necessary!

CLIPPER MANUFACTURING CO.
CONCRETE SAW DIVISION
2804 E. WARWICK, KANSAS CITY 8, MO.
Send FREE Literature, Information and Prices on the NEW CLIPPER CONCRETE SAWS SC

NAME _____
COMPANY _____
STREET _____
CITY _____ STATE _____

GERALD G. GREULICH, consulting engineer of Pittsburgh, Pa., and Washington, D.C., receives Army emblem and Certificate of Appreciation "for outstanding patriotic service to the Department of the Army during World War II." Mr. Greulich was cited, in particular, for his wartime service in the Office of the Chief of Engineers in designing and making available the pierced steel landing mat "that proved to be an important factor in the successful conclusion of the war." The presentation was made by Brig. Gen. Gordon E. Textor, Assistant Chief of Engineers for Military Operations, in the presence of many high-ranking officers and friends.

H. G. Baity, professor of sanitary engineering in the School of Public Health at the University of North Carolina, has been named to the advisory panel of the World Health Organization.

Maurice L. Brashears, Jr., district geologist in the Ground Water Branch, Water Resources Division of the U.S. Geological Survey, at Mineola, N. Y., has returned to his position there after serving as an expert on water supply to the Supreme Commander of the Allied Forces in the Pacific and to the Japanese government.

Ernest F. Brater has been advanced to the rank of professor of hydraulic engineering at the University of Michigan.

Marvin L. Brown, first lieutenant, Department of the Army, Fayetteville, Ark., has been assigned to Mather Air Force Base, Calif.

R. G. Tyler, professor of sanitary engineering at the University of Washington, has been appointed a member of the public health unit of the United Nations Medical Teaching Mission to Israel. During July and August Professor Tyler visited water-ozonation plants in England and France and met with other scientists at the World Health Organization's headquarters in Geneva, Switzerland, for briefing on the Israel mission.

(*Continued on page 90*)

NOW

100% Serrated
SAFETY GRATING
BY A.O. SMITH

After 10 years' experience designing and building safety steps and running boards for railroad cars, A. O. Smith now offers you a 100% serrated safety grating. Both bearing and cross bars are serrated for 100% non-slip safe footing under all conditions.

Rely upon A. O. Smith, known for its three quarters of a century of engineering achievements in automotive, chemical, brewing, petroleum and other fields for:

Floor grating • Stair treads
Catwalks • Trenching • Manways
Running boards

A.O.Smith
Safety Grating and Stair Treads

District Offices: Chicago 4 • Dallas 2
Houston 2 • Los Angeles 22 • New York 17
Pittsburgh 19 • Tulsa 3

CERTAIN TERRITORIES STILL AVAILABLE TO DISTRIBUTORS

A. O. Smith Corporation
Grating Division, Dept. CE-951
Milwaukee 1, Wisconsin

Without obligation send me complete information on your Safety Grating.

Name _____
Firm _____
Address _____
City _____ Zone _____ State _____
☐ I am interested in a Distributorship.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 W. 40th ST.	84 E. RANDOLPH ST.	100 FARNSWORTH AVE.	57 POST ST.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All applications should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Register Now With Your Personnel Service!

The Engineering Societies Personnel Service, Inc. has many outstanding engineering positions available throughout the United States and for foreign service. Make your availability known to the office of the Engineering Societies Personnel Service, Inc., nearest your home. Never before in the 30-year history of the Service has there been greater opportunity for members of the engineering profession in all its branches, mechanical, electrical, civil, mining and metallurgical, chemical, naval architecture, etc. Now is the time to find the opportunity you have been waiting for, but the initial step must be taken by you.—Alfred H. Meyer, Executive Director.

Men Available

JUNIOR ENGINEERING ASSISTANT; ASCE, Student Chapter; B.S. (sought) senior now; age 24. Supervision of construction work, installation of substructure and superstructure of power plant extension, erection of cooling tower, boiler alterations, handling field work reports, correspondence, contracts and specifications. C-688-148 Chicago.

CIVIL ENGINEER; M. ASCE; licensed professional engineer and land surveyor; degrees B.S. in C.E., M.A. in mathematics, C.E. in structural engineering, M.S. in C.E.; age 40; 15 years' experience in teaching, planning, designing industrial buildings, sanitation, and oil refinery work. At present employed as chief engineer with architectural and engineering firm. Desires change and work of responsible and administrative character. Will consider a teaching position. C-689.

CIVIL ENGINEER; M. ASCE; B.C.E.; age 27; designer, field or office engineer; 1¼ years as structural engineer on design and detail of reinforced concrete beams, footings, water conduit, etc., also structural steel for substations; 4 months as construction management engineer, checking drawings, concrete cooling, preparing specifications. C-690-153 Chicago.

CIVIL ENGINEER; Jun. M. ASCE; 30; married; B.S. in C.E., some graduate work; 3 years Navy CEC; one semester instructor in engineering mechanics; 4½ years Bureau of Reclamation; 3 years designing canal structures; 1½ years in district office on varied preconstruction work. Prefers job with consulting firm in central United States. C-691-154 Chicago.

CIVIL ENGINEER; Jun. M. ASCE; 26; married; veteran; B.E., Yale University, 1949; E.I.T.; over a year of varied highway and bridge experience. Layout and supervision of grading and structure construction for the State of California. Short time in subdivision engineering office. Desires permanent position East or foreign in construction engineering. C-692-517 A-11 San Francisco.

PATENT ENGINEER; Jun. M. ASCE; for patent, or related position; B.S. in E.E., Union College, 1948; LL.B., Harvard University, 1951; formerly patent examiner, multiplex telegraphy and automatic signalling systems, United States Patent Office; other patent experience with R.C.A. Patent Research Department; details forwarded upon request. C-693.

STRUCTURAL DESIGNER; Jun. M. ASCE; 26; married; B.S.C.E., 5½ years' experience as architectural and structural designer, all types of buildings from residences to industrial structures. Desires responsible position in architecture, engineering, or construction. Locate anywhere. C-694.

CIVIL ENGINEER; M. ASCE; registered New York State; 49; married; over 25 years' experience in design and construction of large industrial plants and commercial buildings, and in aggregates production and transit mixed concrete. Extensive knowledge of specifications, contracts and purchasing. C-695.

CIVIL ENGINEER, Assoc. M. ASCE; 33; married; licensed professional engineer; 9 years' experience in structural design, water supply and sanitary design, preparation of specifications and administrative experience as head of design section. Desires association with consulting engineer or architect, or position with general contractor. C-696-5012 A-4 San Francisco.

CIVIL ENGINEER; M. ASCE; 36; civil graduate with 14 years' experience in design, specifications, estimating, planning and construction of permanent airfields, roads, sewer, water and drainage systems and housing; 4 years in Guam, Okinawa, Philippines and Japan. Top level experience in administrative and liaison assignments. C-697.

CIVIL ENGINEER; Jun. M. ASCE; B. of C.E., June 1950; married; one year with Bureau of Reclamation (GS-7), on field and office irrigation surveys and design. Desires position in construction, structural or estimating work in central New York State. C-698.

Positions Available

SALES ENGINEER, 30-40, electrical, civil, or mechanical degree, experienced in sales work in the electrical field, with knowledge of a foreign language, for manufacturers of wire, rods, and strands used by utilities, telephone systems, and railroads. Considerable traveling. Territory, eastern or mid-central United States. Headquarters, Pennsylvania. Y-5494.

ENGINEERING INSPECTOR, civil graduate, or mechanical engineer with all-around basic training in engineering, to follow various building and construction projects to make sure that the contractors and subcontractors are performing the work in accordance with specifications. Salary, $4,800-$5,400 a year. Location, Connecticut. Y-5524.

CONSTRUCTION SUPERINTENDENT to take complete charge of erection of large steam-electric power station from the foundation until the units are cut in. Salary open. Location, Brazil. Y-5630.

GENERAL CONSTRUCTION MANAGER, graduate engineer, with minimum of 10 years' experience in supervising construction, to follow up scheduled construction jobs in the field. Salary open. Considerable traveling. Headquarters, New York, N.Y. Y-5654.

FIELD ENGINEER, 26-35, civil graduate, with industrial construction experience, to do field engineering for refinery construction company. Considerable traveling. Salary, $5,200-$6,500 a year. Headquarters, New York, N.Y. Y-5672.

CHIEF ENGINEER, 35-50, mechanical or civil engineer, with at least 10 years' design experience covering heavy industrial cranes, to supervise design engineers and draftsmen for well established firm manufacturing custom-built heavy handling equipment and industrial buildings. Salary, $9,000-$12,000 a year. Location, Northwest. Y-5685.

CIVIL ENGINEERS. *(a)* Civil Engineer, drainage, with at least 8 to 10 years' experience in design and construction of drainage and sewer systems for road and airport construction. Must have thorough knowledge of and be able to select proper materials and to supervise field installations. Estimating, planning, and layout experience also required. One-year contract. Salary $11,180 a year including allowances. *(b)* Civil Engineer, paving and materials, with 8 to 10 years' highway and airport construction experience. Must be familiar with all types of asphalt and concrete paving and have had experience in the preparation and methods of laying these materials. Must be able to plan and direct paving operations, in both kinds, with the use of modern paving machinery. Some estimating and layout work involved. Salary, $11,180 a year including allowances. One-year contract. Location, foreign. Y-5692.

SPECIFICATION WRITER, graduate engineer, majoring in structures, to assist in the development of recommended codes, standards, and specifications of national scope. Must have ability to analyze results of laboratory research and testing, to prepare drafts of recommended requirements, to participate in group discussions concerning building safety, and to cooperate with public officials in dealing with safety problems. Location, Washington, D.C. Y-5727.

JOB ENGINEER, civil, who has had considerable experience on heavy construction for project which will include piers, powerhouse, railroad, etc. Possibility of taking family at later date. Salary, $9,600-$10,800 a year. Location, Chile, at sea level. Y-5755.

PLANT CONSTRUCTION ENGINEER, 35-40, civil graduate, with 5 to 10 years' experience in charge of construction installation and repair for process industry. Salary, $6,000-$7,000 a year. Location, central New Jersey. Y-5829.

PLANT ENGINEER, civil graduate, 40-50, with 15 years' maintenance and construction experience, to take charge of new plant construction and alterations, power and equipment maintenance for textile mills. Salary, $8,000-$10,000 a year. Location, Pennsylvania. Y-5847.

ENGINEERS. *(a)* Civil Engineer, 35-50, with field and design experience in water distribution and sewerage systems, to take charge of municipal project for American consulting firm. Salary, $9,500-$12,000 a year. *(b)* Assistant Civil Engineer, 26-35, with field or design experience in water works and sewage field. Salary, $7,200-$9,600 a year plus quarters and subsistence. Location, West Africa. Y-5851.

RESEARCH ENGINEER, about 40-45, civil with M.S. or Ph.D. and at least 10 years' supervisory research experience in the field of structures and materials, including development of equipment, to take charge of 50 engineers and scientists on government project. Salary, $10,000 a year. Location, California. Y-5877.

DESIGNERS for reinforced concrete and structural steel, with 2 to 3 years' experience working in state highway department or municipal engineering office on highway layout and design; some building and bridge design experience desired. Housing available. Salary up to $7,200. Location, south Wisconsin. T-8023.

WRITER, civil engineer, to do editorial work for an engineering trade paper. Desirable to have some knowledge of production and processing of non-metallic minerals. Some traveling. Car required. Salary, $3,640 a year plus expenses. Location, Chicago. Company will help on fee. R-8038.

ARCHITECTURAL SUPERINTENDENT. Architectural or civil engineer with 10 to 15 years' experience in building construction work, preferably in institutional-type buildings. Supervise building of new construction work for a large educational organization. Salary, $6,600 a year. Location, Chicago, Ill. R-8056.

ESTIMATOR, over 40 years of age. Knowledge of commercial and industrial building estimating and quantity take-off. Actual duties will be office engineering with a contractor on commercial and industrial building: Quantity services, subcontract awards, and general office procedure and estimating jobs. Salary, $6,000-$7,200 a year. Location, Tennessee. T-8057.

RESEARCH OPPORTUNITY

Graduate in engineering for research and development problems in fluid flow involving water, air and steam. Man with several years of experience in experimental techniques and laboratory procedure is desired. Well equipped laboratory located in Ohio. Send complete details of education and experience in communication to:

Box C. E. 197
CIVIL ENGINEERING
33 West 39th Street, New York 18, N.Y.

MATERIALS RESEARCH OPPORTUNITY

Graduate in physics or metallurgical engineering needed for study of material properties under simulated service conditions of stress, temperature, atmosphere, etc. Knowledge of materials properties and experimental testing techniques important. Well equipped laboratory in Ohio. Send complete details of education and experience in communication to:

Box C. E. 198
CIVIL ENGINEERING
33 West 39th Street, New York 18, N.Y.

RESEARCH STRESS ANALYST

For projects involving stress and strain measurements. Experience in experimental research techniques using strain gages, brittle lacquers, etc., is desirable. Work is primarily on pressure vessels, heat exchange equipment, and the study of materials for such service. Knowledge of theoretical stress-strain relationships also desirable. Well equipped laboratory located in Ohio. Send complete details of education and experience in communication to:

Box C. E. 199
CIVIL ENGINEERING
33 West 39th Street, New York 18, N.Y.

engineers designers & checkers draftsmen

PIPING
STRUCTURAL STEEL
REINFORCED CONCRETE
Pressure Vessels
Heat Transfer
Instrumentation
Mechanical Equipment

How YOU Can Profit From Kellogg's 50 Year Success Story

Our constantly expanding operations and our consistent policy of promoting from within are your best guarantees for future opportunity and progressional growth. Our senior engineers will confirm the encouragement and financial recognition given their individual efforts while The M. W. Kellogg Co. was attaining its leadership in the design and development of oil refineries and chemical plants throughout the world.

CLIP THIS HANDY COUPON *NOW!*

THE M. W. KELLOGG CO.
225 BROADWAY, NEW YORK 7, N. Y.

Mr. Martin Coyne
The M. W. Kellogg Co., 225 Broadway, New York 7, N. Y.

Please send me an application form for one of the profitable positions now open at The M. W. Kellogg Co.

NAME .....
ADDRESS .....
CITY ..... STATE .....

"I'm a BOEING engineer!"

You'll say that with pride. Men who can meet Boeing engineering standards share the prestige of leadership. They are doing vitally important work in the most challenging of all fields.

Boeing's Engineering Division has been growing steadily for 35 years. Today, it offers extraordinary career opportunities for the following:

Experienced and junior aeronautical, mechanical, electrical, electronics, civil, acoustical and weights engineers for design and research; servo-mechanism designers and analysts; and physicists and mathematicians with advanced degrees.

Here, at Boeing, you'll find stability and opportunity. You'll face the challenge of working on such vital programs as the B-47 and B-52 jet bombers, guided missiles and other revolutionary developments. Openings are available at both Seattle and Wichita. Your choice of location — the Midwest or Pacific Northwest. You'll enjoy good salaries that grow with you, and Boeing provides a moving and travel expense allowance.

Yes, you'll be proud to say, "I'm a Boeing engineer!"

WRITE TODAY TO THE ADDRESS BELOW OR USE THE CONVENIENT COUPON

JOHN C. SANDERS, Staff Engineer—Personnel
DEPT. S-9
Boeing Airplane Company, Seattle 14, Wash.

Engineering opportunities at Boeing interest me. Please send me further information.

Name _____

Address _____

City and State _____

News of Engineers

(*Continued from page 87*)

Charles E. Schaffner, since 1946 associate professor of civil engineering at the Polytechnic Institute of Brooklyn, has accepted appointment to the post of director of the evening session of the institute. A consultant on materials testing and stress analysis, Professor Schaffner is an expert examiner for the New York City Civil Service Commission. He succeeded **Cornelius Wandmacher,** who is now head of the University of Cincinnati Civil Engineering Department.

Charles E. Schaffner

John R. Noyes, for the past three years Commissioner of Roads for Alaska, at Juneau, has been assigned to duty at the New York Port of Embarkation in Brooklyn in connection with the supply of the American Forces in Europe. **A. F. Ghiglione,** who has been chief engineer for the Alaska Road Commission, has been designated acting Commissioner of Roads.

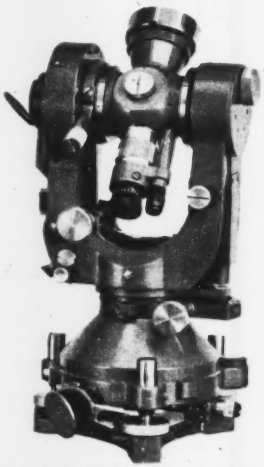
Martin J. Orbeck has been elevated to the rank of professor of mechanical and engineering drawing at the University of Michigan.

W. E. Ross recently resigned as city engineer for Richmond, Ind., in order to devote his entire time to duties as sewage disposal superintendent there. Previously he held both positions.

George E. Symons has resigned as managing editor of *Water & Sewage Works*, New York City, to establish his own consulting service, with headquarters in Larchmont, N. Y. He will specialize in plant and laboratory design, research, and operation problems in the field of water, sewage, and industrial waste treatment. Dr. Symons will serve as contributing editor for *Water & Sewage Works*, and will continue as consultant to B-I-F Industries of Providence, R.I.

George E. Symons

Rolland George Sturm, formerly professor of engineering mechanics and professor of materials at Purdue University, has been appointed director of the Auburn Research Foundation and director of the Engineering Experiment Station at Alabama Polytechnic Institute. He also acted as consultant to the Atomic Energy Commission.



T2... UNIVERSAL THEODOLITE

The recognized instrument for triangulation, bridgework and other precise engineering jobs... The instrument for you.

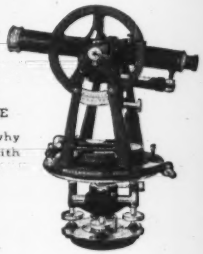
You read both circles by microscope direct to 1". Every reading gives the mean of two diametrically opposite points of the circle, therefore free from eccentricity-errors.

Due to the optical plummet, centering above a ground point is easily and quickly done even on windy days. The telescope, with a big field of view, is easy on the eye and can be transited both ways... Choose Wild instruments for ease of operation, speed and accuracy.

For detailed information ask for Booklet CVE-9

HENRY WILD
SURVEYING INSTRUMENT SUPPLY CO.
OF AMERICA, INC.
26 COURT ST., BROOKLYN 2, N. Y. TRiangle 5-0644

10 Days FREE Trial



PROVE for yourself — on your job — the advantages of WARREN-KNIGHT Transits and levels:

NO OBLIGATION TO PURCHASE

Examine these features and see why you get greater value per dollar with our transits and levels:

At Our Risk and Expense

- Sturdier Construction —special reinforcing
- Extra fine coated lenses. Flat, brilliant, close focus 4½ feet.
- Disappearing Stadia
- Graduations differentiated size and slant:
- Right angle peep sight through telescope angle.
- Balanced internal focusing telescope.
- Non-cramping leveling head.
- Replaceable leveling screws; threads covered.

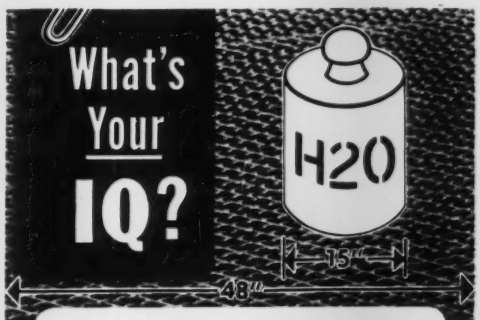
Send for Our Catalogue

A 1-cent post card will do. Just ask for 10th Edition Catalogue CE 19. It's free.

WARREN-KNIGHT CO.

Manufacturers of Warren-Knight Transits and Levels

136 N. 12th Street • Phone LOcust 7-3984 • Philadelphia 7, Pa.



KERLOW IQ-35 STEEL BRIDGE FLOORING, as shown above, will carry H20 loading on a 15" circle up to a span of 48" and weighs only about 19 lbs. It is the safest, strongest floor ever made. KERLOW makes superior gratings for bridges, highways, industrial plants . . . floors, slabs, armoring, sidewalks, safety steps, drain grates, trench covers, grid trays, tote boxes and pallets. Lighter in weight, stronger, with exclusive performance features. Before you specify, before you buy, write for documented, informative catalog that tells you why your first line of steel-grating supply is

KERLOW STEEL FLOORING CO.

27 Mallory Ave., Jersey City, N. J.

KERLOW

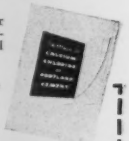
For Concrete Construction...

SOLVAY Calcium Chloride

STEPS UP COLD WEATHER SCHEDULES — REDUCES COST

Here's the story of what Calcium Chloride will do for cold weather concrete construction—and its effect on Portland Cement. You can step up cold weather schedules and reduce costs . . . lengthen the pouring day . . . cut costly protection time in half . . . reduce or eliminate overtime finishing with the addition of Solvay Calcium Chloride to your concrete mix. For details, send for "The Effects of Calcium Chloride on Portland Cement," a 40-page semi-technical book—the result of research conducted by nationally recognized authorities, giving details of carefully controlled tests made in the field and in the laboratory.

BOOK AVAILABLE ON REQUEST—For your copy of "The Effects of Calcium Chloride on Portland Cement," fill in and mail this coupon today—there's no obligation.



SOLVAY SALES DIVISION

Allied Chemical & Dye Corporation

40 Rector Street, New York 6, N. Y.

Please send my copy of "The Effects of Calcium Chloride on Portland Cement."

Name_____

Title_____

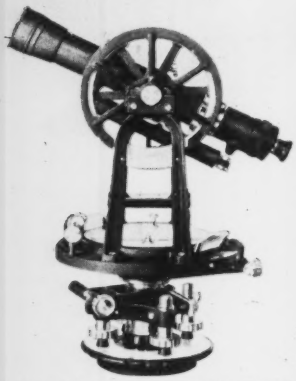
Company_____

Address_____

City_____ Zone_____ State_____ CE-9

No other Instrument gives you

SO MUCH PROTECTION!



NOTICE the leveling screws on the instrument leveling head above. See how they are always totally enclosed — regardless of their position "in" or "out". This means all dust and dirt are sealed out — their precision sealed in.

This is just one of the many extra protective refinements, extra features that guarantee you extra-long life and super precision results with David White Instruments. There are other things too — the waterproof compass box, the overall weatherproof morocco finish—coated optics—hand-fitted, anti-friction, virgin hard, bell metal centers—plus the David White improved engraved plate levels with counter adjusting springs.

Yes, for instruments that guarantee you the extra in precision and long life you want — it's David White . . . makers of finest quality instruments for over 40 years. For detailed information about the complete David White line of Transits, Universal Level Transits, Levels, Theodolites and engineering supplies, write today for Catalog No. 1048.

DAVID WHITE COMPANY

359 West Court St.
Milwaukee 12, Wis.

We offer the most expert Repair Service — on all makes of Instruments.

S. Y. Symns has become a partner in the Cleveland, Ohio, firm of Wilbur Watson Associates, Engineers. Mr. Symns has been affiliated with the organization for the past eleven years, serving in various capacities including that of chief engineer. Before that he was with the U.S. Coast & Geodetic Survey on work in connection with extension of the primary control system for surveys of the United States.

S. Y. Symns

Leo Max Legatski, previously assistant professor of civil engineering at the University of Michigan, has been appointed associate professor.

A. A. Lewis has been named acting regional engineer for the U.S. Bureau of Reclamation's Southwestern Region, at Amarillo, Tex. Mr. Lewis has been in the Bureau's office at Amarillo since 1946.

W. L. Lowe-Brown has retired from his connection with the firm of Sir M. MacDonald & Partners, London, England. He expects to open his own office at 39 Victoria Street, in that city.

John C. Luthin is now manager and engineer of the Monterey Bay Water Co. and engaged in private practice as a consultant in water utility engineering and management, with headquarters at Santa Cruz, Calif. For the past five years he has been superintendent of the Santa Cruz Water Department.

John S. Macdonald, vice-president of the Walsh Construction Co., New York City, has been made president of the General Contractors Association.

Martin A. Mason, chief of the Engineering and Research Branch and chief engineer of the Army's Beach Erosion Board, has been named dean of the School of Engineering at George Washington University, Washington, D.C. Dean Mason received the Army's Exceptional Civilian Service Award in 1945 for his reports on landing beaches, which were used in planning amphibious operations in all theaters of operation.

Jack R. Barnes, formerly hydraulic engineer for the Ground Water Division of the U.S. Geological Survey at Plainview, Tex., is now a member of the firm of White, Guyton & Barnes, consulting ground-water hydrologists, with headquarters in Austin, Tex.

Robert S. Holmes, executive secretary of the Institute of Traffic Engineers, has been granted a one-year leave of absence to accept an assignment with the Federal Civil Defense Administration. He has been appointed deputy director of the Engineering Services Division and will assume general engineering and public works responsibilities, to include traffic engineering. Mr. Holmes has been executive secretary of the Institute of Traffic Engineers since 1947.

Are you turning in all your SCRAP?

Don't wait for "George" to do it

You'll find your local scrap dealers listed in the yellow pages of the phone directory.

IF you are a steel user, this important job of getting more scrap back to the mills is directly up to *you*. You just cannot afford to sit idly by while the scrap shortage gets worse. For unless everyone really pitches into this job of digging out all the scrap possible, steel production is bound to suffer, and every steel user, in more or less degree, will suffer too.

More scrap means *more* steel—it's as simple as that.

Right now some mills have only a bare two-days' supply of scrap on hand. Others have even less. Some steel-making furnaces already have had to shut down for lack of scrap. The situation is serious. Only you can help improve it.

By turning in every piece of worn-out equipment, every obsolete tool and machine, in fact every pound of iron and steel scrap you can comb out of your plant, you'll be helping relieve the worst scrap shortage since Pearl Harbor days . . . and the steel industry will be able to produce more of the steel you need.

Remember—it takes at least one-half ton of scrap to make one ton of steel. To maintain steel's present high production schedules requires more than 1400 carloads of industrial scrap *every* day. So turn in your scrap—ALL your scrap—and keep the mills rolling. This is more than a shortage. It's an emergency that vitally concerns you—and us—and the Nation.

This page would ordinarily be used to tell you about

AMERICAN WELDED WIRE FABRIC

but, because without SCRAP we cannot produce steel, we are asking instead for your all-out help in getting more SCRAP to the mills.

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

1-1348

UNITED STATES STEEL

RECENT BOOKS

Les Barrages en Terre

A treatise covering present practice in the design and construction of earth dams is presented by Mallet and J. Pacquant. The authors deal with the handling of flood waters, infiltration and danger from leaks, protection against leakage by various means in both the substructure and upper works. The major section provides a detailed analysis of the stability of earth dams under various conditions, and the book ends with a chapter on selection of materials and construction methods. (Editions Eyrolles, 61 Boulevard Saint-Germain, Paris, 1951, 345 pages, 2,500 frs.)

Construction with Moving Forms

In this volume L. E. Hunter considers the design and use of vertical slip forms for the construction of tall concrete bins, silos and other simple structures. The construction of forms, procedure for their use, description of the concrete plant used, reinforcement methods, and special applications are discussed. A special chapter is included on horizontally travelling forms for sewers, culverts, sea-walls, etc. Numerous illustrations accompany the text. (Concrete Publications, Ltd., 14 Dartmouth St., London, S.W. 1, 1951, 56 pages, $1.75.)

Engineering and Western Civilization

This book by J. K. Finch outlines the history of engineering from the earliest beginnings, some fifty centuries ago, to modern times, noting and commenting upon the accompanying economic and social conditions and their relation to technological development and progress. A conscious attempt is made to avoid technical details and to present the story in a suitable historical perspective. An extensive annotated bibliography is provided for those wishing further details. (McGraw-Hill Book Co., New York, N.Y., 1951, 397 pages, $5.)

Engineering Materials Manual

A collection of special sections originally published in the magazine, *Materials and Methods*, this book provides descriptive information and reference data on the engineering materials used in industry. Its 28 sections, edited by T. C. DuMond, cover such materials as iron, steel, stainless steel, aluminum, magnesium, copper alloys, plastics, rubber, ceramics, and several types of finishes and coatings. Two of the relatively new materials considered are beryllium copper and high-strength, low-alloy steels. (Reinhold Publishing Corp., New York, N.Y., 1951, 386 pages, $4.50.)

Elementary Theory and Design of Flexural Members

In addition to discussing beam, slab and column design in general terms, *Elementary Theory and Design of Flexural Members*, by Jamison Vawter and James G. Clark, of the University of Illinois, deals with detailed designs of simple flexural members in steel and reinforced concrete. It is appropriate to use as an elementary textbook on design to follow courses in strength of materials and to precede the usual courses in building and bridge design. (John Wiley & Sons, Inc., New York, 1950. 215 pages, $4.)

Engineers of the Southwest Pacific 1941–1945, Volume VIII. Critique.

Reviewing the work of the Corps of Engineers, this volume is a compilation of conclusions, criticisms, and recommendations, presented in narrative form by campaign from the beginning to the end of World War II in the Southwest Pacific. Problems covered include engineer organization, administration, intelligence, amphibian and combat operations, construction, capacity and adequacy of personnel, training, and supply. Prepared by the Office of the Chief Engineer, Pacific. Reports of Operations, U.S. Army Forces in the Far East, 1950. 451 pages, $5.75, for sale by Superintendent of Documents, Government Printing Office, Washington 25, D.C.

Guide to Geologic Literature

First book of its kind, *Guide to Geologic Literature*, by R. M. Pearl, covers the literature of the world in geologic and related fields, and provides a key to books, maps, abstracts, periodicals, indexes, bibliographies, government documents, newspaper articles, theses and other publications. It also provides information and advice on the use of libraries and the availability of special library services. An attempt is made to indicate availability and methods of finding desired material. (McGraw-Hill Book Co., New York, Toronto, London. 1951. 239 pages, $3.75.)

Highway Engineering

Intended for use as a text by junior and senior civil engineering students, *Highway Engineering*, by L. J. Ritter, Jr. and R. J. Paquette, surveys the whole field with emphasis on administration, economics, financing and planning. Starting with general factors, the book continues with design and the preparation of plans and contracts, soil engineering, construction methods, materials and maintenance. Special effort is made to reflect the best current thought in details of practice. (Ronald Press Co., New York, 1951. 721 pages, $6.50.)

Laboratory Design

This National Research Council report on design, construction, and equipment of laboratories—edited by H. S. Coleman—presents authoritative up-to-date advice and essential data on laboratories for research and educational institutions and for the industries. An effort is made to indicate the constructional materials, facilities, services and equipment of both teaching and industrial laboratories. Concise descriptions are given of some modern laboratories. A selected bibliography is included. (Reinhold Publishing Corp., New York, 1951. 393 pages, $12.)

You're burying your money's worth . . .

when you specify WARREN CAST IRON PIPE

You can be *sure* you get 100 cents to the dollar when you plan your piping system around *WARREN* Cast Iron Pipe and *WARREN* Cast Iron Fittings.

WARREN Cast Iron Pipe is produced in all sizes from 2" to 84" with all types of joints . . . fittings in numerous non-standard patterns to meet unusual requirements.

STRENGTH ... TOUGHNESS ... RESILIENCY ... MEAN MAXIMUM LIFE!

Warren FOUNDRY & PIPE CORP.
55 LIBERTY STREET, NEW YORK 5, N. Y.
Bell & Spigot Pipe • Flange Pipe • Mechanical Joint Pipe
Flexible Joint Pipe • Short Body Bell & Spigot Specials
WARREN PIPE CO. OF MASS. INC. 75 FEDERAL ST. BOSTON, MASS.

95 Years of Continuous Service

foremost in
WATER MEASUREMENT
and
CONTROL INSTRUMENTS
SINCE 1907

Throughout the world wherever precision measurement is required for proper use and control of water, STEVENS instruments have been a standard of quality since 1907.

Whether the need is a simple staff gage, float gage or complex remote operated recorder, there is a STEVENS instrument to meet the requirement. STEVENS recorders give automatic registration of water levels or liquid flow for daily, weekly or longer periods of unattended operation; automatic control of alarms or pumps; direct float operation or remotely controlled operation.

VISUAL, GRAPHIC OR AUDIBLE REGISTRATION

Measure deep wells; gage rivers, streams, irrigation ditches and reservoirs; measure sewage flow, assemble accurate permanent records of any liquid surface fluctuation. The STEVENS line is complete in the field of water measurement and control.

SEND FOR YOUR FREE COPY

STEVENS DATA BOOK

A MUST FOR YOUR REFERENCE FILES

Puts interpretive data at your fingertips. Contains information on float wells and instrument shelters. Complete hydraulic tables. Information on STEVENS water measuring instruments.

Inquiries regarding special liquid measurement or control problems are invited.

LEUPOLD & STEVENS INSTRUMENTS, INC.
4445 N. E. GLISAN • PORTLAND 13, OREGON

Materials Handling Case Book

Presenting a selection of articles from *Factory Management and Maintenance*, this book provides 190 specific approaches to materials-handling problems. The articles are arranged in chapters according to where in the plant the problem exists. There are three indexes, listing kind of equipment used, kind of product handled, and company name. The editors are L. K. Urquhart and C. W. Boyce. (McGraw-Hill Book Co., New York, N.Y., 1951, 440 pages, $8.)

(The) Prefabrication of Houses, a Study by the Albert Farwell Bemis Foundation of the Prefabrication Industry in the United States.

Combining the approach of the economist, architect, and engineer, this book, by B. Kelly, surveys the prefabrication industry. It covers its history and future possibilities, financial and managerial problems, design and production processes, and implications for the rest of the building industry. Numerous plates illustrate the techniques used by several of the large companies. Lists of companies in this field and an annotated bibliography are included in the appendix. (Published jointly by the Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1951. 466 pages, $7.50.)

Strength of Materials

Strength of Materials, by F. L. Singer, is devoted to the analysis and design of members subjected to axial, torsional and flexural loads, and combinations of these basic types of loadings. Principles are developed by means of a consistent plan which first relates stresses to deformations, then applies the equations of static equilibrium, and finally satisfies the boundary conditions. Numerous illustrative problems show in detail how principles are applied, and there are problems for student solution. (Harper & Brothers, New York, 1951. 469 pages, $5.)

Symposium on Corrosion of Materials at Elevated Temperatures

Sponsored by the Gas Turbine Panel of the ASTM-ASME Joint Committee on the Effect of Temperature on the Properties of Metals, this symposium—presented at the ASTM meeting in Atlantic City, N.J., on June 26, 1950—consists of eight papers and discussion. The behavior of materials in atmospheres from all the common fuels for mobile and stationary power generation is discussed. The engineering materials considered range from mild steel to ceramics with numerous superalloys in between. The role of protective coatings is also treated. (Published as Special Technical Publication No. 108 of the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1951. 121 pages, $2.25.)

Toll Roads and the Problem of Highway Modernization

Concerned with highway economics and administration, this book, by W. Owen and C. L. Dearing, analyzes the advantages and disadvantages of the toll road; indicates the basic defects in state and federal policy which have led to its revival; and suggests changes in public policy that are necessary to restore the effectiveness of highway management. (Brookings Institution, Washington, D.C., 1951. 204 pages, $2.50.)

Water Treatment for Industrial and Other Uses

This comprehensive book, by E. Nordell, on industrial waters should be of practical value to all whose work involves their use. The first four chapters are devoted to impurities in water supplies and how they can be eliminated or reduced. Chapter Five concerns industrial water requirements and water-treatment practices. The next two chapters describe the problems and practices relating to boiler feed waters and cooling waters. The remainder of the text covers the different processes and equipment used in treating water. The appendix contains 43 tables of conversion factors and equivalents and three curves for use in calculations. (Reinhold Publishing Corp., New York, N.Y., 1951. 526 pages, $10.)

GIVES DETAILED
UP TO DATE INFORMATION

IRRIGATION ENGINEERING

Volume I: Agricultural and Hydrological Phases

By IVAN E. HOUK
Consulting Engineer

Stresses engineering know-how

Written by an authority with over 40 years' experience, this new book includes brief summaries of results of the more intensive field and laboratory investigations completed to 1951. It evaluates the variable factors involved in irrigation work . . . devotes special attention to aspects of irrigation which have become important in recent years . . . gives definitions, data, discussions, reference to source material and much other important information for engineers and technicians in this field.

CHAPTERS:

Introduction
Irrigation Soils
Soil Fertility
Moisture in Irrigation Soils
Soil-Moisture Movements
Climatic Factors
Runoff and Streamflow
Snow Melting and Runoff Forecasting
Evaporation from Water Surfaces
Land Evaporation and Transpiration
Irrigation Water Supplies
Quality of Irrigation Water
Irrigation of Saline and Alkali Soils
Irrigation Preparation and Procedure

1951 545 pages **$9.00**

Mail coupon now for 10-day free examination.

APPROVAL COUPON
JOHN WILEY & SONS, INC.,
Dept. CE-951
440 Fourth Ave., New York 16, N. Y.
On 10 days' approval, send Houk's *Irrigation Engineering, Vol. I*. I will remit $9.00 plus postage or return book postpaid. (Offer not valid outside U. S.)
Name .....
Address .....
City, Zone, State .....
SAVE POSTAGE. We pay postage if you enclose $9.00. Money back on same return privilege.

Another *tough* foundation problem solved with

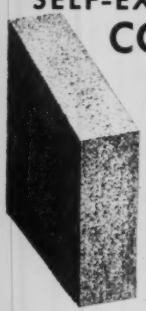
DRILLED-IN TRADE MARK CAISSONS

Cylinders installed through 60 feet of highly plastic clay and socketed into anorthosite rock.
Locked in the Rock
Executed for FRASER-BRACE Engineering Co., Inc.

Puyjalon River crossing abutment supporting plate girder railroad bridge. Cylinders were battered 1:6 both longitudinally and transversally with bridge.

DRILLED-IN CAISSON CORPORATION
2 PARK AVENUE, NEW YORK 16, N. Y.
Affiliated with
• SPENCER, WHITE & PRENTIS, NEW YORK
• WESTERN FOUNDATION CO., NEW YORK

Servicised
SELF-EXPANDING CORK



- EXPANDS 150% BEYOND ORIGINAL THICKNESS
- FULLY COMPRESSIBLE
- NON-EXTRUDING AND RESILIENT
- SUPPLIED ½" TO 1" THICK—2" TO 12" WIDE

Self-expanding cork is ideal for large concrete structures or masses where substantial initial contraction is anticipated before any considerable amount of expansion takes place. 150% expansion of Self-Expanding Cork even after full compression, keeps the joint space filled, regardless of concrete movement. Supplied in ½" to 1" thicknesses; 2" to 12" (Standard) widths; also made in 24" and 36" widths on special order.

SERVICISED QUALITY PRODUCT 1938

Write for catalog and complete details on Servicised Joint Fillers and Sealers.

SERVICISED PRODUCTS CORP.
6051 W. 65th ST., CHICAGO 38, ILL.

SPECIFICATION WRITERS

The American Association of State Highway Officials has just released its official publication on "Specifications for General Provisions."

This is a *MUST* book for Engineers who prepare highway specifications. No engineering reference library is complete without it. Now available—Price $2.00.

Order direct from American Association of State Highway Officials
917 National Press Building
Washington 4, D. C.

New Publications

Rubber Roads. The 1951 edition of the National Rubber Bureau's booklet, *Stretching Highway Dollars with Rubber Roads*, revised by Harry K. Fisher, incorporates all the facts, experiences, and conclusions developed to this point in the use of rubber roads. Copies are available without charge from the Natural Rubber Bureau, 1631 K Street, N.W., Washington 6, D.C.

Water Resources. A *Report to the Legislature on the Development of the Water Resources of Florida*, for 1949 and 1950 is now available. Brief descriptions are presented of authorized projects, both in the planning stage and in the process of being constructed. This work for the Central and Southern Florida Flood Control District is under the guidance of the Water Survey and Research Division of the State Board of Conservation. Further information may be obtained by writing to the Office of the Chief Engineer, Division of Water Survey and Research, State Board of Conservation, Tallahassee, Fla.

Welding. Issuance of a book, *New Lessons in Arc Welding*, based on instructions given at the Lincoln Arc Welding School, is announced by the Lincoln Electric Co. Information on new procedures for better welding, identification of metals, automatic and semi-automatic hidden arc welding procedures, and other material are included in this 20-page illustrated volume. Copies may be obtained from the Lincoln Electric Co., Cleveland, Ohio, for $1 each in the United States, and $1.50 elsewhere.

Fire-Resistant Masonry Construction. Studies indicating that the fire resistance of walls of concrete masonry units is governed to a large extent by the type of aggregate used are detailed by the National Bureau of Standards in BMS 120, entitled *Fire Resistance of Walls of Gravel-Aggregate Concrete Masonry Units*. It was found that units made of calcareous aggregates, such as limestone and dolomite, are more resistant to fire than those made with siliceous aggregates, generally consisting of pebbles of quartz, chert, or flint. Copies may be obtained at 15 cents each from the Government Printing Office, Washington 25, D.C.

Biological Warfare. *What You Should Know About Biological Warfare* is the title of official U.S. Government booklet, Publication PA-2 of the Federal Civil Defense Administration. Defense measures planned in case of germ warfare are presented in a simplified manner. Individual copies are 10 cents each (with a 25 percent discount for orders of more than 100), from the Superintendent of Documents, Washington 25, D.C.

Irrigation. A method of estimating water requirements for irrigated lands where only climatological data are available, is outlined by Harry F. Blaney and Wayne D. Criddle in a publication of the Soil Conservation Service entitled *Determining Water Requirements in Irrigated Areas from Climatological and Irrigation Data*. Copies may be obtained from the Printing and Distribution Unit of the Section of Education, Soil Conservation Service, Washington, D.C.

Housing Research. All contract research projects started by the Housing Research Division of the Housing and Home Finance Agency are described in a booklet entitled *Housing Research, Capsule Descriptions of Projects Started Under Contract in 1950*. The projects are focused on solving the practical problems of housing production, financing, and operation, for the mutual benefit of the housing industry and the consumer. Copies of the report are obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., for 30 cents each.

Water Resources. Bulletin No. 40 of the Illinois State Water Survey, giving records of water levels, well data, analyses of treated waters, and information about ground water and other water resources of the state, is now available. Material is arranged according to counties, and data for each county may be obtained individually if so desired. Inquiries should be sent to the State Water Survey Division, Water Resources Building, Box 232, Urbana, Ill.

Corps of Engineers Research. A demonstration of the feasibility of the use of sector gates to fill the Algiers lock chamber under heads as great as

Gratings may LOOK alike but.....there's a BIG DIFFERENCE in KLEMP WELDED OPEN STEEL GRATING

Our grating is different because it's made BETTER... *stronger!* The hexagon crossbars of our welded grating are electro-forged into the carrier bars under 200,000 lbs. pressure and 1500 KVA. This provides a one-piece assembly *without notches*, that can't come apart. Our 43 years' experience insures perfect fabrication to your specifications. Moreover, we make gratings and open steel meshes *only*, and do not compete with our customers in the iron and structural steel trade.

Send for our new Grating Catalog today!

KLEMP SURE FOOTED AS A CAT — OPEN STEEL FLOORING

WM. F. KLEMP COMPANY

"Steel Flooring Specialists"

6610 S. Melvina Ave. Chicago 38, Illinois

NOW AVAILABLE

GLOSSARY: WATER AND SEWAGE CONTROL ENGINEERING

A Wealth of Engineering Terms, 276 pages with 4,200 Definitions and Cross References

Price $2.00

(50% discount to members for first copy)

A limited number of cloth bound copies available at only $1.00 extra per copy.

SEND AT ONCE USING THE COUPON BELOW

American Society of Civil Engineers
33 West 39th Street, New York 18, N. Y.

Please forward "GLOSSARY: Water and Sewage Control Engineering," as indicated.

☐ ..... copies paper covered at $2.00

☐ one copy only " " " 1.00 (To Members)

☐ ..... copies cloth bound at $3.00

☐ one copy only " " " 2.00 (To Members)

Payment is enclosed herewith

Name .....

Grade Membership .....

Address .....

City .....

DEGREE-GRADED TO HAIRLINE TOLERANCES...

THE All-New MICROTOMIC

Newly-developed quality controls make and keep the All-New MICROTOMIC Pencils *absolutely uniform!* In any given degree MICROTOMIC leads are *always identical!* Write a test order for New MICROTOMICS *now!*

NEW FEATURES YOU'LL READILY APPRECIATE

COLOR—Dusk Gray—voted most distinctive, least distracting, by hundreds of draftsmen. New 'bull's-eye' degree marking is on 3 sides of pencil—easier to find on any drafting board.

LESS SMUDGE on tracings! MICROTOMIC's 100X graphite leaves fewer loose, smearable particles! New, strong, slow-wearing HI-DENSITY Woodelinched leads!

BETTER PRINTS... MICROTOMIC lines are exceptionally opaque to the actinic rays of high-speed 'printers'—reproduce dead white, without feathering or blurry edges!

TRY THE "3-against-3" test

Test 3 All-New MICROTOMICS against 3 of your present drawing pencils. *See for yourself* which brand is more uniform. Your Dealer has MICROTOMICS—Order some—test them—today!

TRADEMARKS REG. U. S. PAT. OFF.

EBERHARD FABER

MARS
Lumograph
AMERICA'S ONLY IMPORTED DRAWING PENCIL
2H
2886 J.S.STAEDTLER, INC MARS LUMOGRAPH
COSTS LESS BECAUSE IT LASTS LONGER!
Everything you want in a drawing pencil is in Mars Lumograph. It gives you the precise thickness and blackness of line you need for crisper, cleaner prints.
PROVE BY TRYING—
Accurately graded in 19 degrees from EXEXB to 9H—now packaged in metal boxes. If your dealer cannot supply you, write us.
Send coupon today for FREE sample.
J. S. STAEDTLER, INC
53-55 WORTH STREET
NEW YORK 13, N.Y.
SEND ME FREE—
Mars Lumograph Drawing Pencil
(____Degree)
J. S. STAEDTLER, INC.
53 Worth Street • New York 13, N.Y.
Name
Title
Firm
Address
City State
Dealer's Name

18.5 ft, is presented in Technical Memorandum No. 2-309 of the Waterways Experiment Station, called *Filling Characteristics, Algiers Lock, Intracoastal Waterway, Gulf Section, Louisiana.* Technical Memorandum No. 3-323, covering *Investigation of Pressures and Deflection for Flexible Pavements, Report No. 1, Homogeneous Clayey-Silt Test Section,* is also available. Both may be purchased from the Waterways Experiment Station, Vicksburg, Miss.—the former for $1 a copy, and the latter for $2.

Wood Preservation. Preliminary wood preservation statistics for 1950—based on reports from 267 plants representing more than 95 percent of the wood-treating capacity of the country—have been compiled by the Division of Forest Economics of the U.S. Forest Service. Copies of the compilation may be obtained from the U.S. Forest Service, Washington 25, D.C.

Atomic Energy. A revised edition of the booklet on how to do business with the Atomic Energy Commission entitled *U.S. Atomic Energy Commission Contracting and Purchasing Offices and Types of Commodities Purchased,* may be bought for 15 cents per copy from the Superintendent of Documents, U.S. Government Printing Office Washington 25, D.C.

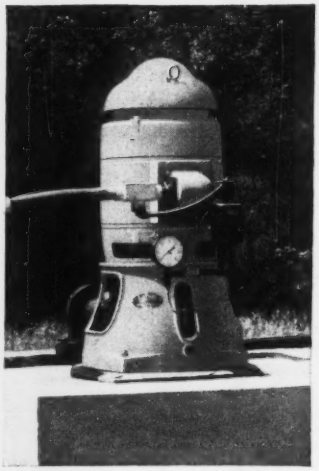
Highway Research. Progress in the field of land acquisition, control of highway access, roadside protection, and parking is outlined in Bulletin No. 30 of the Highway Research Board, entitled *Progress in Roadside Protection.* The bulletin includes a committee report, and four special papers pertaining to control of the roadside are also included. Inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Building Research. The Building Research Advisory Board announces publication of the proceedings of its second research correlation conference under the title, *Fire Resistance of Exterior Non-Load-Bearing Walls.* New developments in design and engineering of exterior non-load-bearing walls, and new materials for construction of these walls under existing codes and regulations are discussed. Copies will be distributed to those who paid the registration fee at the conference, with additional copies available upon order. An order form with information on prices may be obtained from the Building Research Advisory Board, National Research Council, 2101 Constitution Avenue, Washington 25, D.C.

Air Transportation. Publication of the *Proceedings of the Conference on Ground Facilities for Air Transportation,* composed of 36 papers and summaries of ensuing discussions, is announced. The conference was held at and sponsored by the Massachusetts Institute of Technology in September 1950, in cooperation with the Port of New York Authority, Civil Aeronautics Administration and the Massachusetts Aeronautics Commission. Copies, priced at $2 each, may be obtained from Prof. A. J. Bone, Massachusetts Institute of Technology, Cambridge 39, Mass.

Surface Water. An over-all view of the current surface water outlook in the United States is presented by a summary of the water situation in each of five major divisions of the country in a report released by the Geological Survey. Entitled *A Summary of the Water Situation in the United States with Special Reference to Surface Water,* the report stresses the interrelation of surface water and ground water and the need for investigating these interrelations. Copies are available for distribution by the Geological Survey, 2238 General Services Building, Washington 25, D.C. The report is also on file in the field offices of the Surface Water Branch, where it may be consulted.

Highway Research. The first of a series of booklets devoted to better roads and highways for New Jersey has been published by the Joint Highway Research Project at Rutgers University. They are Reports 1 and 2 in a 22-bulletin series on the Engineering Soil Survey of New Jersey conducted jointly by the New Jersey State Highway Department and the State University's Bureau of Engineering Research. Report No. 1 outlines the procedures followed in conducting the study and presents conclusions regarding New Jersey as a whole. Report No. 2 concerns Essex County only. The remaining 20 will each treat the soils of an individual county. The reports are obtainable from Rutgers University, Bureau of Engineering Research, New Brunswick, N.J., at a nominal cost.



FOR THE CITY OF
TOMS RIVER,
New Jersey

With her population more than doubling during the summer season, the resort city of Toms River, New Jersey was facing a serious water shortage. Five old, inefficient and not too dependable wells were being operated with suction pumps. Layne was called in for a discussion of what could be done with limited funds. Layne's recommendations resulted in a contract for the rebuilding and re-equipping of one old well and the drilling and equipping of a new one. The contract also called for an auxiliary, gasoline engine drive on one of the pumps for use in case of electric power failure. Without delay everything was finished according to the contract, giving the city of Toms River a water supply that more than fulfills their present needs.

Layne handled everything complete in one inclusive contract that saved the city officials much time, useless expense and unnecessary worry. Layne offers this same type of service to any city or industrial plant in need of more well water.

NEW CATALOGS

Layne offers, without obligation, a wide range of catalogs and bulletins on well water systems, short coupled service pumps, oil and water lubricated pumps, irrigation wells and pumps, etc. You may obtain copies by addressing

LAYNE & BOWLER, INC.
General Offices, Memphis 8, Tenn.

Layne
WATER SUPPLY
WELLS & PUMPS

Soil Mechanics. The first of a series of booklets devoted to better roads and highways for New Jersey has been published by the Joint Highway Research Project at Rutgers University. They are Reports 1 and 2 in a 22-bulletin series on the *Engineering Soil Survey of New Jersey* conducted jointly by the New Jersey State Highway Department and the State University's Bureau of Engineering Research. Report No. 1 outlines the procedures followed in conducting the study and presents conclusions regarding New Jersey as a whole. Report No. 2 concerns Essex County only. The remaining 20 will each treat the soils of an individual county. All inquiries should be addressed to the College of Engineering, Rutgers University, New Brunswick, N.J.

Applications for Admission to ASCE, July 14—August 11

Applying for Member

LAWRENCE LEONIDAS CHAPMAN, Oklahoma City, Okla.
FRANK DAVID COOPER, Glenview, Ill.
EDWARD HAYDEN COWAN, Juneau, Alaska.
CLYDE ARTHUR DOW, Portland, Oreg.
EVERETT WESLEY DUNN, Washington, D.C.
WILLIAM MARCUS FALLER, New York, N.Y.
MORTON MITCHELL FLINT, Juneau, Alaska.
ROBERT ALEXANDER HARRIS, Jackson, Miss.
WILBUR WRIGHT HOAGLAND, Long Beach, Calif.
RICHMOND PEARSON HOBSON, Arlington, Va.
JOHN BERNARD KIELY, Juneau, Alaska.
JACK RUSSELL NEWVILLE, Los Angeles, Calif.
GILBERT HUME ROWE, Columbia, S.C.
ALEXANDER VASILEVICH SKVORZOV, Hong Kong, China.
HUGH ADAM STODDART, Juneau, Alaska.
EDWIN PAUL SWATEK, JR., Pittsburgh, Pa.
ALBERT JACOB WEGMANN, Baltimore, Md.
WALTER R. WEISSEL, Basle, Switzerland.

Applying for Associate Member

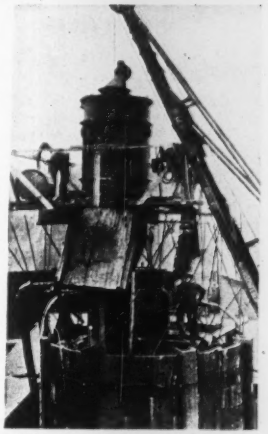
KISHINCHAND MULCHAND BHATIA, New Delhi, India.
CHANDRAKANT KANAIYALAL CHOKSHI, Bombay, India.
MONINDRA NATH DAS, Hazabirah, India.
EDWARD JOSEPH DEPINA, Hyde Park, Mass.
MICHAEL EDWARD GIBB, London, S.W.1., England.
ALBERT ABRAHAM GOLDBERG, Boston, Mass.
JOHN DANIEL HARMS, Vicksburg, Miss.
JOHN JACKIMIEC, Chicago, Ill.
PERCY ALLEN JONES, Detroit, Mich.
MATTHEW FRANCIS KARCICH, Denver, Colo.
EDWIN EUGENE KINNEY, Chicago, Ill.
GORDON ARDIS MARSALIS, Shreveport, La.
JOSÉ AUGUSTO MARTINS, Sao Paulo, Brazil.
HARRY SHATTUCK MASON, JR., San Gabriel, Calif.
RALPH GEORGE MATHEWSON, Kansas City, Mo.
AUGUST WILLIAM NOACK, JR., Baltimore, Md.
JOSEPH PERAINO, New York, N.Y.
BYRON JONATHAN PRUGH, New York, N.Y.
ANTHONY FRANK ROMEO, Washington, D.C.
NIKHILESWAR SANYAL, Jabalpur, India.
ROBERT DAVID SCHACHERL, Cochabamba, Bolivia.
LEON FRANKLIN SILBERBERGER, East Aurora, N.Y.
ALVARO SILVA-MUJICA, Bogota, Colombia.
JAMES BRYAN SMITH, Dayton, Ohio.
IRVING L. SOFFER, New York, N.Y.
DERYK POTTER SPIKER, Atlanta, Ga.
BHUPATIRAJU SUBBARAJU, Madras, India.
RUDOLPH HENRY TAUSKEY, New York, N.Y.
ROSCOE FRANK THOMAS, Albuquerque, N. Mex.
HAROLD LEON WATERMAN, Middlesex, England.
DAMERON HENRY WILLIAMS, JR., San Francisco, Calif.
FRED NIXON WISEHART, Louisville, Ky.
NAI CHEN YANG, Mount Holly, N.J.

Applying for Junior Member

JAMES MICHAEL AUSTIN BYRNE, Lindfield, N.S.W., Australia.
GRANT TURNER KEITH, Regina, Sask., Canada.
JAMES JENSEN KESLER, Los Angeles, Calif.
LAWRENCE MORRIS, Arverne, N.Y.
CHARLES JOSEPH REICH, Boulder, Colo.
EGERTON HAROLD RIDDLE, London, England.
JOHN HOWARD SNELLING, Pittsburg, Calif.
JOHN JOSEPH STEWART, Akron, Ohio.
MARVIN CLIFFORD STIPPES, St. Louis, Mo.
BAKER HULL TROUPE, St. Louis, Mo.
PHILIP FRANCIS ZACCHEO, Kingston, N.Y.

[Applicants for Junior membership from ASCE Student Chapters are not listed.]

COMMERCIAL IMPROVED TUNNELING PRACTICE



Plain liner plates used as external skin and concrete form in pneumatic drop caissons on each side of Flushing River Gas Service Tunnel, Long Island City, New York

FOR CAISSONS AND SHAFTS!

• COMMERCIAL Liner Plates, fabricated without corrugations, find an important application in the field of drop caissons of circular shape. Besides effecting decided savings in decreased construction time, the smooth surface of COMMERCIAL plates materially reduces the skin friction of the surrounding earth. As for vertical shafts, used in collaboration with horizontal tunnels, COMMERCIAL Liner Plates offer a money and materials saving method of driving these shafts. By their use, the shaft may be concreted or reinforced with ribs to make it self-sustaining. These examples of COMMERCIAL Liner Plate use are only two of many applications. Write to us . . . we'll send you detailed information concerning liner plates for every tunneling job.

THE COMMERCIAL SHEARING & STAMPING CO.
P. O. BOX 719 YOUNGSTOWN 1, OHIO

DIFFICULT FOUNDATION WORK

- FOUNDATIONS
- UNDERPINNING
- SHEETING & BRACING
- PILING & SHEETING
- SHORING
- COFFERDAMS
- MOVING STRUCTURES
- SPECIAL SERVICES

Write for revised catalog

Leaders in scientific design and construction of difficult foundation work, Spencer, White & Prentis provide engineering know-how that can be an important cost saving factor on any job, small or large, particularly when completion in a minimum construction period is vital.

SPENCER, WHITE & PRENTIS, INC.
10 East 40th Street, New York 16 • Hammond Bldg., Detroit, Mich

In Canada
Spencer, White & Prentis of Canada, Ltd.
2052 St Catherine's St., W • Montreal, Quebec

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Hydraulic Dragshovel

THE HYDROHOE, a completely hydraulic truck mounted dragshovel, has just been announced. The unit has special features, which make trenching and other specialized digging faster and easier. These include two separate digging actions; precision control permitting fraction-of-inch movements; hydraulic ejector on dipper; no bails, sheave blocks or drag ropes on jobs. Easily converted in the field to clamshell or crane service, the machine hoists beams, slabs, concrete buckets, places pipe, tanks, hydrants, and handles many miscellaneous lifting, setting and material handling jobs. Another distinct advantage is the hydraulic ejector built into the dipper. By pushing the load out with a positive forcing action, the

Hydrohoe

the bucket to interfere with loading; and rapid conversion to clamshell or crane in the field. Force for the machine's primary digging action is applied by a hydraulic ram located between the boom and the dipper handle. A second, separate and distinct digging motion comes from the telescoping of the boom. By hydraulically extending and retracting the boom, the operator reportedly makes a level, scallop-free cut, digs across pipe and buried cable, excavates in front of and behind boulders to roll them free—all without moving the machine an inch. The machine with its telescoping boom and precise hydraulic control, capable of traveling at speeds up to 50 mph on open highways, is especially suited to the needs of contractors on widely scattered, short term ejector eliminates the jerking and jarring necessary to shed sticky material with a conventional bucket. This ejector is reported to step up the efficiency of the Hydrohoe's regular 18-in. bucket and also make possible the use of a narrow 12-in. bucket, a size normally impractical because of clogging. Every work function of the Hydrohoe is fully hydraulic-boom hoist, swing, dipper dig and dump, boom telescope, outrigger set and retract and positive dirt ejector. The Hydrohoe is reported to work effectively to a 12-ft 6 in. depth over rear of truck, and has a maximum reach of 23 ft. It is operated by the regular truck engine, furnishing power to hydraulic pumps through a power take-off. **Bucyrus-Erie Company, South Milwaukee, Wis.**

Radial Engine

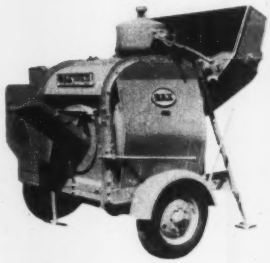
THE 1820 HP Nordberg gas burning radial engine is the first of 80 similar power generating units being built for an aluminum reduction plant in Louisiana. The radial engine is of the two-cycle type, having eleven cylinders of 14 in. bore and 16 in. stroke. The engine develops its rated horsepower at 400 rpm and will drive 1290 kw direct current generators. They are gas burning and spark fired. Cylinders of the radial engine are equally spaced radially about a vertical shaft and are located in a horizontal plane. The firing order is consecutive around the circle. Perfect balance is achieved by actual convergence of combustion pressures and inertia forces at one focal point on the crankshaft axis. The compact cylinder arrangement not only reduces engine room floor space to $^1/_2$ the usual requirements, but also permits the engine to be transported as a complete unit from the factory to site of installation. **Nordberg Manufacturing Company, Milwaukee 7, Wis.**

Floor Patching Compound

PERMANENT REPAIRS to chuck holes or breaks in concrete floors can be made easily and quickly during working hours by using Por-Rok quick setting cement. Application is fast and simple. Merely clean out the hole or break, mix Por-Rok with water, and pour into the opening. Por-Rok is self-binding, will not shrink, and requires no trowelling for a perfect finish. The patch is ready for light loads in 15 min, normal trucking in 30 min, and heaviest loads within one hour. Por-Rok's amazing compression strength of 4500 lbs per sq in. is verified by an independent testing laboratory. **The Hallemite Manufacturing Co., Dept. CE, 2446 West 25th St., Cleveland 13, Ohio**

Concrete Mixer

NOW IN PRODUCTION is the 6-S concrete mixer. It is built for fast production on jobs needing a 6 cu ft mixer. The water tank has been relocated to the top of the mixer to permit faster water entry, faster batching, more concrete per hour. It is now equipped with a "see-in" clear, unbreakable plastic check valve for elimination of guesswork in the water supply. Eliminating practically all service problems and costs, the improved water valve can be completely overhauled (when required by wear) by simply replacing two rubber washers and one rubber "O" ring. A "one-arm" control for clutch and brake greatly simplifies the operator's movements and speeds up production. For greater durability and longer life, pillow blocks have replaced bushings on the counter shaft, and bearings are now used on the winding drum. All these improvements are added to the standard advantages such as shimmy ship, one man spotting, low gravity center, chain drum drive, and rugged, yet light-weight construction. **Chain Belt Company, 1600 W. Bruce St., Milwaukee 4, Wis.**



6-S Mixer

WOOD RESISTS FIRE

if it is

CZC(FR)® WOOD

To all the advantages of wood—its easy workability, availability, decorative value, economy, re-use value—is added the important quality of fire-retardance. For CZC (FR) is wood with Koppers Chromated Zinc Chloride (FR) treatment which controls spread of fire and afterglow . . . puts wood in the *fire-safe* class.

Proved in Use

Under actual fire conditions, chemically-protected wood has come through with flying colors. For example, a sudden, fierce fire broke out in a structure built with Koppers Fire-Retardant Wood. Not only was the fire quickly brought under control and extinguished, but no serious structural damage resulted.

Resists Decay

Even if you never have a fire, CZC (FR) Wood is a good investment. It is fortified against decay and termite attack as well as against fire. The Koppers Treatment is odorless, does not greatly change the color of wood, nor interfere with its paintability.

Send for Booklet

Wherever wood is vulnerable to fire, use CZC (FR) Wood. It helps to protect buildings, contents and people against fire hazards. For complete details send for our free booklet, "Koppers Fire-Retardant Wood."

KOPPERS COMPANY, INC., Pittsburgh 19, Pa.

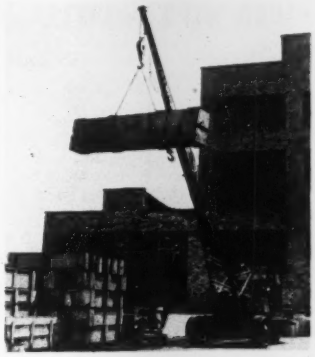
KOPPERS PRESSURE-TREATED WOOD

KOPPERS

Equipment, Materials & Methods (Continued)

Industrial Radio System

AN EXTENSIVE MOBILE 2-way radio system is used as a combination industrial communications network and as a plant protection facility at the Eastman Kodak plant. Twenty-four vehicles including trucks, cranes, tractors, fork-lift trucks and railroad locomotives are equipped with Motorola FM 2-way radios. As a result, useless movement time of these vehicles is



Equipped with 2-Way Radio

reduced to a minimum because they now move from job to job without wasting time to return to a telephone or to the dispatcher's office for further orders. The system, meanwhile, is used to coordinate plant protection and civil defense activities, including use by plant guards and for fire protection. When need for emergency action arises, response is immediate. Repair and maintenance units can be contacted instantly in case of machinery breakdown, and in a matter of minutes production facilities can be operating normally. Fire-trucks and fire-fighting and other plant protection personnel respond quickly to communications via 2-way radio. **Motorola, Technical Information Center, 4545 W. Augusta Blvd., Chicago 51, Ill.**

Masonry Drill Bit

A CARBIDE TIPPED masonry drill bit called the Cyclo-Core with removable Cyclo-center is now being distributed. The drill bit is designed for precision drilling in concrete, glazed tile or other hard masonry materials using a rotary type drill with pressure applied, for holes $^3/_4$ in. diameter and up. Removable Cyclo-center does away with the necessity of using a wood template to start holes. When inserted, it accurately locates and starts a hole. As soon as the hole is spotted; Cyclo-Center is removed. This

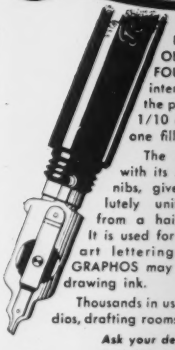
(*Continued on page 102*)

54 Pens in One!

WORLD'S ONLY DRAWING INK FOUNTAIN PEN WITH Interchangeable Nibs

Pelican

Graphos



Here is the world's ONLY DRAWING INK FOUNTAIN PEN with interchangeable nibs . . . the pen that draws a line 1/10 of a mile long with one filling.

The Pelican GRAPHOS, with its 54 interchangeable nibs, gives you lines absolutely uniform in thickness from a hairline to $^3/_8$" thick. It is used for technical drawing, art lettering, and sketching. GRAPHOS may be filled with any drawing ink.

Thousands in use in leading art studios, drafting rooms all over the world.

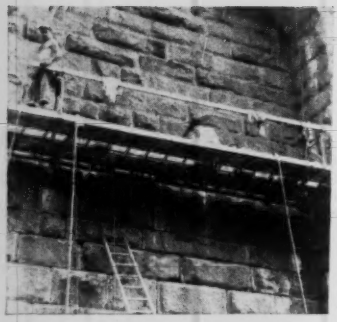
Ask your dealer — or write for illustrated booklets

JOHN HENSCHEL & CO., Inc.
105 EAST 29th STREET
NEW YORK 16, N. Y.

SHOWN ½ ACTUAL SIZE

Pelican
Waterproof Drawing Inks
in cartridges and 1-oz. bottles

— permit drawing finest lines without breaks or running. Completely waterproof, free-flowing, fast-drying. Opaque black and 19 vivid colors — blendable and dilutable. In 1-oz. bottles, cartridges, and larger containers.



STONE R. R. VIADUCT REPAIRED WITH "GUNITE"

The above photographs show a large stone viaduct belonging to an eastern Railroad. This structure, built in 1888, was originally designed for a single track, but was later changed to accommodate double tracks. Increased locomotive weights and power caused the mortar in the joints to chink out due to vibration. Cement Gun crews made the viaduct "as good as new" by repointing the joints, and grouting one of the arches over the Highway.

This job of repointing the masonry joints and the grouting was accomplished by using the "CEMENT GUN" nozzle for filling the joints.

Many other instances of repair, remodeling and new construction with "GUNITE" are described and pictured in Bulletin B2400. A request, on your letterhead, will bring a free copy by return mail.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN

ESL BIBLIOGRAPHIES

No. 1. Filing Systems for Engineering Offices. 41 references. 1948. $2.00.

No. 2. Prestressed Reinforced Concrete. 190 references. 1948. $4.00.

No. 3. Precision Investment Casting by the Lost Wax Process. 111 references. 1949. $2.50.

No. 4. Pallets Used in Modern Materials Handling. 114 references. 1949. $2.00

No. 5. Machinery Foundations; Design, Construction, Vibration Elimination. 120 references. 1950. $2.00

No. 6. Non-Metallic Bearings. 101 references. 1950. $2.00.

No. 7. Domestic and Industrial Applications of Solar Heating. 149 references. 1950. $2.00.

No. 8. Management of Construction Jobs. 53 references. 1950. $2.00.

•

LIBRARY SERVICES AVAILABLE
LITERATURE SEARCHING
TRANSLATING
PHOTOPRINT AND MICROFILM COPYING

•

Ask for Descriptive Folder

Engineering Societies Library
29 West 39th Street, New York 18, N. Y.

SPEAKING Can Be Easy

. . . for Engineers, too

A concise, practical, pocket size illustrated manual for better speaking and meetings. Organized for your greatest convenience in preparing and delivering effective oral presentations and in conducting interesting meetings. Printed in two colors.

~

Among other subjects, this manual includes: selecting the type of presentation, planning and preparing, attention patterns, platform manners, visual aids, microphone techniques, effective chairman, introductions with a punch, handling the questions, panel discussions, and bigger and better audiences.

~

Copies are available at 50 cents. Special discounts in lots of 100 or more.

~

Order directly from:

Engineers' Council for Professional Development at 29 West 39th Street, New York City.

Please send me . . . copies "Speaking Can Be Easy."

Name: .....

Address: .....

City: .....State: .....

Equipment, Materials & Methods (Continued)

unique accessory also does away with walking of the bit or marring of the surface being drilled. Dust is expelled by Cyclo-Core as it drills because of the machined in spiral threads running the full length of the body. These threads make automatic runways for removing dust from the hole as it is cut. Each bit has a port opening for cleaning out the core. Cycle-Core is one of three bits in a team of carbide tipped drill bits designed to drill any size hole in any kind of masonry. Write for drill bit selector chart. **New England Carbide Tool Co., Cambridge 39, Mass.**

Copying Machine

THE INTRODUCTION of a low-cost copying machine, the Model 20, for making copies in all phases of business and industry, has been announced. Because of its low cost, advanced engineering, and copying width, the machine offers special value to both business and industry. Engineers, designers, and chief draftsman will find it ideal for the medium volume production of prints from tracing, engineering drawings, and other large sized technical originals.

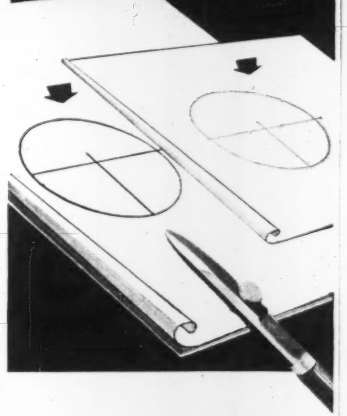
Model 20

The Copyflex machine offers a 46-in. printing width with exposure speeds up to 95 in. per minute. The Model 20 requires no installation, just a connection to a 60 cycle, 115 volt, alternating current electric line. 50 and 25 cycle machines also are available. Copies may be made on Copyflex sensitized paper, acetates, films and cloths. They are handled safely and conveniently under ordinary factory or office illumination, so no special lighting is needed. Dark rooms, developing trays, etc., also are unnecessary, and, since no vapor developer is used, there is no need for exhaust ducts or extra ventillation. Operation of the Model 20 does not require any special training. The operator merely feeds the sensitized medium into the machine with the translucent original to be copied. Copies are processed by the machine and are stacked ready for use. **Charles Bruning Company, Inc., 100 Reade Street, New York, N. Y.**

Imperial

TRACING CLOTH

THAT DEFIES TIME!



• The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

Imperial

TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

Equipment, Materials & Methods (Continued)

Vibrator

RUBBER TIPS are considered standard equipment on a complete line of interchangeable electric, pneumatic and gasoline vibrators. After more than a year of use under actual operating conditions, wherein they proved satisfactory, it was decided to extend the advantages of the rubber tip to the laboratory model. Among the advantages of rubber tips is that they can be used on moisture absorbent form lining materials and plaster of Paris moulds in laboratory and experimental work with a minimum of damage to the forms. The vibrator is recommended for use in vibrating test cylinders or beams, both laboratory and field, and is widely used in college and commercial laboratories. It is also used in making concrete products, small scale hydraulic structures and in all experimental work. The Model 11 is 27 in. in length from hand grips to lower end with an outside diameter of $1^{9}/_{16}$ in. Powered by a Universal $^{1}/_{4}$ hp electric motor it has a vibrating speed of over 10,000 rpm. It weighs approximately 15 lbs net. The rubber tips can be easily replaced by merely unscrewing worn part and installing a new tip. **Viber Company, 726 S. Flower, Burbank, Calif.**

Model 11

Grating

PRODUCTION OF A new development, Grip-Strut grating, for use wherever a non-skid grating surface is required, is announced. The grating appears as a diamond shaped pattern in which the percentage of open area is in excess of 75 percent of the total recticulated surface. The struts or vertical members are joined by integral saddles to create lateral struts of great strength. The material used for the manufacture is sheet steel or aluminum of gauges ranging from 12 to 16. Metal for forming into longitudial channels, step risers, step nosing or mouldings is integral with the grated surface, eliminating the need and cost of welding in many applications. Great strength coupled with light weight recommends Grip-Strut for a great variety of applications. In usages such as railroad running boards, cat walks, work platforms, steps, etc., its anti-skid features are also of great importance along with the fact that its unique structure makes possible cleaning with a brush or broom. **Globe Company, 4000 S. Princeton Ave., Chicago, Ill.**

The Moretrench catalog tells you how. Send for your copy.

MORETRENCH CORPORATION
90 WEST STREET
NEW YORK 6, NEW YORK
Chicago, Ill. - Tampa, Fla. - Houston, Tex.

See how you can cover many more underwater miles per day by the use of this new electronic equipment.

See how you can increase survey accuracy: how you can actually record the survey run and find material composition of the bottom, electronically, without specimen sampling.

SEE why more army engineers prefer and specify the BLUDWORTH Echo Recorder.

Details and price, Model ES-123 available on request.

BLUDWORTH MARINE 92 Gold Street, New York, N. Y.

Please send me FREE copy of Study.

Name .....
Title .....
Firm .....
Address .....

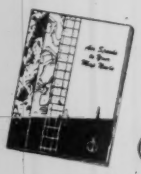
SAVE MONEY!
SPEED WORK!

on Engineering and Location

Jack Ammann contour maps are produced with civil engineering accuracy and they are proving indispensable in many departments of state and municipal governments as well as in the industrial and business field.

Send for this FREE book

"AIR SPEEDS TO YOUR MAP NEEDS"



The graphic story of how Jack Ammann services can help you.

JACK AMMANN
PHOTOGRAMMETRIC ENGINEERS
SAN ANTONIO, TEXAS

Equipment, Materials & Methods (Continued)

Road Material

A LONG-LASTING ROAD material known as Komac, which, unlike present materials used for patching, may be applied in any kind of weather, can be stock-piled in readily usable form throughout the winter and laid down without heating, using standard road-repair equipment. Much of the road repair work now done in winter forms only temporary patches which must be replaced in summertime. The road material is made by mixing special bituminous binders with aggregates to form a premix which has qualities long sought after for road construction and maintenance purposes. The resulting premix, pressed into chuck-holes of streets or roads, makes a long-lasting patch. Special advantages of the material noted by contractors who have assisted in making tests are: it is mixed cold in any type of mixing equipment; it can be stock-piled during the summer and fall at strategic places and removed easily from the stockpile in any kind of weather including coldest winter days; and it does not adhere to hauling or spreading equipment. Also, the material need only be tamped or rolled into the holes in the pavement; it can carry traffic immediately after it is rolled; it does not "bleed" or push out of position in hot weather; and it shows great resistance to skidding. **Koppers Company, Inc., Pittsburgh 19, Pa.**

Specify the specialized services of the Western Waterproofing Co.

FOR CONCRETE RESTORATION

You're sure of fully responsible performance when you specify Western Waterproofing Company . . . assured by trained technicians, sound engineering methods, specially prepared and proved materials. More than 35 years' experience.

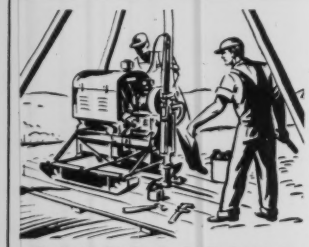
Other Western Waterproofing Services Include:

Genuine Ironite Waterproofing
Building Restoration • Gunite
Building Cleaning • Tuckpointing
No materials for sale—Nation-wide service
For specific data, write:

WESTERN WATERPROOFING CO.
Engineers & Contractors
SYNDICATE TRUST BLDG., ST. LOUIS 1, MO.

Building Block

YTONG, KNOWN TODAY through Europe as a light, strong, easy-to-work and cheap building block is ready to make its American debut. It offers an answer to the problem of finding a cheap, lightweight building block that will substantially reduce the current high cost of building. First of all, Ytong has greater strength in compression than any other light concrete—1000 lbs per sq in. That means that walls can be both structural and heat insulating. Ytong walls are dry, warm and draught-proof. The material does not burn; an 8-in. Ytong wall is fireproof. It does not rot or crack and gives good sound insulation for a quiet building. In addition, it is frost-resistant, forms an excellent plaster key and is free from destructive ingredients. Walls are never damp; no rain can come through. It is a light product—looks like a petrified sponge. It can be made in suitable dimensions and gives a minimum of joints to save mortar and shorten building time. With all these qualities of strength and durability, Ytong can be worked like wood—cut, sawed, plugged. It can be produced in 20 by 10 in. blocks and 2 to 14 in. thick. In fact, it can be manufactured in any appropriate standard size. Ytong can be used for; building blocks, lintels, slabs, insulating slabs and for roof slabs. For complete information on American production rights of Ytong, write to **American Nayo Corp., NBC Building, Cleveland, Ohio**



CONTRACTORS
for
DIAMOND CORE DRILLING
DRY SAMPLE SOIL BORINGS
FOUNDATION TESTING
PRESSURE GROUTING, ETC.
anywhere in the world

Sixty years of successful experience, backed by superior equipment and ample financial resources, constitute your best possible assurance of satisfactory service. Estimates submitted promptly on request. Manufacturers, also, of Diamond Core Drilling Machines and complete accessory equipment.

SPRAGUE & HENWOOD, Inc.
Dept. C. E., SCRANTON 2, PA.
New York - Philadelphia - Pittsburgh

LEFAX★★★
POCKET SIZE TECHNICAL DATA BOOKS $1 EACH

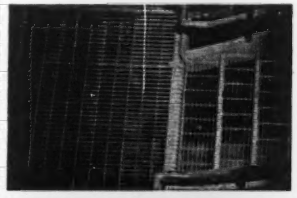
Printed on loose leaf, six hole, 6¾" x 3¾" bond paper, each book contains about 140 pages of technical data, presenting condensed, accurate and essential data for the student, engineer, technical worker and business man.

Architecture	Transformers,
Home Heating	Relays, Meters
Illumination	Hydraulics
Electrician's Data	Surveying
Builder's Data	Mech. Drawing
Lumber Data	Machine Design
Air Conditioning	Machinists' Data
General Math.	Piping Data
Math. Tables	Surveying Tables
Physics	Trig-Log Tables
Chemical Tables	Metallurgy
Metals	Analytic
Gen'l. Chemistry	Chemistry
Reinforced Concrete	Highway Engineering
Building Construction	Mechanics of Materials
Radio	Power Trans. Mach'y.
Television & FM	Thermodynamic Tables & Charts
Electricity, AC	Phys. & Thermo-dynamic Data
Electricity, DC	Phys. & Org. Chemistry
AC Motors and Generators	

Write for FREE Catalogs (over 2000 listings). See for yourself how helpul LEFAX can be to you. Send $1 for each book, or $5 for any six books listed above, to:

LEFAX, Dept. CIV-8, Philadelphia 7, Pa.

For the best
RIVETED
PRESSURE-LOCKED
WELDED
GRATING
for
WALKWAYS
FLOORING
BALCONIES
STAIR LANDINGS
STAIR TREADS
in
INDUSTRIAL PLANTS
REFINERIES
SEWAGE PLANTS
WATER WORKS
Specify—
IRVING GRATINGS



IRVING SUBWAY GRATING CO., INC.
ESTABLISHED 1902
Offices and Plants at
5008 27th St., Long Island City 1, N. Y.
1819 10th St., Oakland 20, Calif.

with "GUNITE"
PRESSURE CONCRETE CO.
gives cement greater utility, versatility!

FOR REPAIRING: Reservoirs, Dams, Filter Plants, Sewage Disposal Plants, Tanks, Stadiums, Bridges, Sea Walls, Breakwaters.

FOR LINING: Reservoirs, Swimming Pools, Tunnels, Sewers, Pipe, Concrete, Brick and Steel Tanks, Stacks, Bunkers, Irrigation Ditches.

FOR CONSTRUCTING: New Tanks, Stacks, Piles, Sidewalls and Roofs, Steel Encasements.

Write for 48-page illustrated booklet showing "GUNITE" at work.

PRESSURE CONCRETE CO.
NEWARK 5, N. J. 193 Emmet Street
CHICAGO, ILL. 33 No. La Salle Street
CHARLOTTE, N. C. Liberty Life Bldg.
FLORENCE, ALA. So. Court Street

Literature Available

HOIST—An advanced type of hoist for long wheelhouse trucks is described in an illustrated bulletin just published. The hoist, the KDLL, incorporates the Hercules center lift design. Its reported advantages are extra lifting power, smoother operation, and longer service life. Ask for Bulletin No. 8051, **Hercules Steel Products Corp., Galion, Ohio.**

PIPING FABRICATION AND ERECTION—To demonstrate the experience and facilities for fabrication and erection of industrial piping, a 24-page illustrated booklet, Bulletin 1700 has been made available. Its many pictures show piping installations in steel mills, for gas transmission systems, central power stations, water pumping stations, heating plants, oil refineries, and chemical process plants. Dravo's engineering and fabrication facilities are also illustrated and described. **Dravo Corporation, Neville Island, Pittsburgh 25, Pa.**

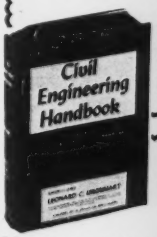
REVOLVER CRANES—A catalog featuring revolver cranes in industrial use has been released. It is a pictorial catalog with views of the huge revolver cranes working at ports and industrial plants throughout the world. It shows many specialized applications for this giant of industry. Contents include short job stories as well as rated lifting capacities of the five standard models. Ask for Catalog No. 400-R-3, **American Hoist & Derrick Co., 63 South Robert St., St. Paul 1, Minn.**

PACKAGED ELECTRIC POWER—A 24-page bulletin on packaged electric power for industry's third—and biggest—expansion is now available. Designated as Bulletin GEA-5000, the publication outlines methods of obtaining electric power equipment for quick expansion at low cost and with a minimum of critical materials. Included are 52 photographs and diagrams. It also offers a list of 31 other G-E bulletins giving full information on available equipment for industrial power expansion. **General Electric Co., Schenectady 5, N.Y.**

TERRAZZO CATALOG—Of interest to architects and builders, a 136-page, loose leaf catalog tells the complete story of Portland Cement Terrazzo, from technical specifications for its installation, to illustrations in color of many of the infinite combinations of color and pattern which can be achieved. Featured are large-size, true color Terrazzo sample plates which are easily removable from the binder to facilitate comparison and selection of a wide range of color combinations. Among the types of information the book offers are data for grounded grill, non-slip, radiant heating and outdoor installations. The price of the volume is $10.00. **National Terrazzo & Mosaic Association, Kass Bldg., Washington, D.C.**

CIVIL ENGINEERING HANDBOOK

1. Brings you up to date on fundamentals, theory, and practice of various subdivisions of civil engineering. Covers surveying—railway, highway, and airport engineering—mechanics of materials—hydraulics—steel—cement and concrete—foundations—sewage disposal—water supply and purification. **Editor-in-Chief, L. C. Urquhart, Consulting Engineer, New York, N. Y., and Colonel, Corps of Engineers; Prof. of Structural Engineering, Cornell U. Newark, N. J. Former 3rd Ed., 976 pages, over 900 illus., $8.50**



HYDRAULIC TRANSIENTS
Just Out

2. Shows you how to solve problems in hydraulic transients by applying arithmetic integration and trial-and-error arithmetic. Filled with actual computations of structures now in successful operation, the book gives a practical means of solving problems in water hammer, surge-tank design, turbine-speed regulation, stability of governing, pressures in pump discharge lines, filling systems for navigation locks, and surges in open canals. **By George H. Rich, Consulting Eng., Chas. T. Main, Inc. 255 pages, 146 diagrams and tables, $7.00**

FOUNDATIONS OF STRUCTURES

3. Here are practical answers to specific problems in the planning and design of foundations. Covers everything from how to gather and interpret data regarding soils, and plan the support of a structure, to how to handle the construction of the foundation. **By C. Dunham. 669 pages, 464 illus., $7.50**

NOMOGRAPHIC CHARTS

4. A collection of 92 time-saving charts for solving everyday problems in general engineering mathematics and the fields of hydraulics, mechanics, thermodynamics, and electrical engineering. Accurate in a range between ordinary slide-rule computation and exact numerical computation. Each chart is followed by a detailed explanation of its use. **By C. Albert Kulmann, 244 pages, $6.50**

Just Out

SEE THESE BOOKS 10 DAYS FREE

McGRAW-HILL BOOK CO., INC.
330 W. 42nd St., N.Y.C. 18

Send me the book(s) checked below for 10 days examination on approval. In 10 days, I will remit for book (s) I keep, plus a few cents for delivery and return unwanted book(s) postpaid. (We pay for delivery if you remit with this coupon: same return privilege.)

☐ Urquhart—**Civil Eng. Handbook, $8.50**
☐ Rich—**Hydraulic Transients, $7.00**
☐ Dunham—**Found. of Structures, $7.50**
☐ Kulmann—**Nomographic Charts, $6.50**

(Print)
Name .....
Address .....
City ..... Zone ..... State .....
Company .....
Position CNG-9-51

This offer applies to U. S. only.

AUTOMATIC
Sewage Regulators

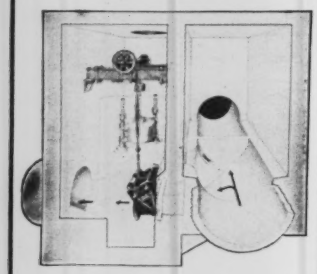


Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

Descriptive Bulletins and Engineering Data Available Upon Request

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

dewater the Complete way

The swiftest, surest dewatering method is also the simplest and most economical. "Complete's" patented fluted tube wellpoints combine compactness with lightness and strength—enable you to handle tougher jobs at lower cost—keep you on firm ground always. Write, wire or phone for estimates—we have the equipment, experience and personnel.

Write today for "Complete catalog Dept. CI

COMPLETE MACHINERY & EQUIPMENT COMPANY, INC.
36-40 11th STREET
LONG ISLAND CITY, N. Y.

Branch Warehouse
3rd AVE. & ADAMS ST.
GARY, INDIANA

Literature Available (Continued)

VERTICAL TURBINE-TYPE PUMPS—An 8-page catalog which describes the Class APH-APK line of vertical, turbine-type pumps is announced. These pumps are particularly applicable to bulk liquid transfer, cooling tower, dewatering and similar services where suction is taken from an open source. Ask for Catalog 7228, **Ingersoll-Rand Company, 11 Broadway, New York 4, N.Y.**

MOTOR TRUCKS—A fully illustrated bulletin, showing a line of heavy duty motor trucks, has just been released. The bulletin illustrates many types of heavy-duty vehicles available, including six-wheelers. It also has sections covering Federal gasoline and diesel engines, special heavy-duty construction features and specifications on the complete line. **Sales Division, Federal Motor Truck Company, Detroit 9, Mich.**

DIESEL ELECTRIC SETS—A 16-page booklet entitled, "Electricity as Required," will be of considerable interest to institutions, contractors, manufacturing industries, and municipalities. The booklet illustrates the wide usage of Caterpillar diesel electric sets on various power applications. It briefly outlines specifications of its models ranging from 21 KW to 314 KW. A special chart for self-regulating and externally-regulated sets is also featured. Ask for Form 30178, **Caterpillar Tractor Co., Peoria 8, Ill.**

EQUIPMENT—A 12-page bulletin illustrates and describes equipment designed and manufactured for the Process Industries. Material is conveniently grouped according to the use for which the equipment is designed, contributing to easy reference. Four pages of the bulletin are devoted to case histories. These show the initial problem, how it was solved, and the actual results, in many different industries. Others in the same line of industry can see how a problem was solved which may be similar to one they are facing. **Infilco Inc., Tucson, Ariz.**

STEEL AND ALUMINUM BUILDING PANELS—"Fenestra Steel and Aluminum Building Panels" is the title of a 1951 catalog containing 38 pages of valuable data. The catalog provides detailed panel selection tables as a guide to choice of the most economical panel for a given span and given load. The detail section has been revised to represent current practice, and the catalog contains numerous photos of job installations completed in the past year. Complete descriptions of and specifications for various Fenestra wall, deck and floor panels are included. **Detroit Steel Products Company, 3139 Griffin St., Detroit 11, Mich.**

PILES

CASED | WOOD
COMPRESSED | COMPOSITE
PRECAST | STEEL PIPE

They're all here . . .

Learn more of the MacArthur story. You will find it in an eight-page booklet available to you. Information about piles, equipment, and jobs is yours for the writing—just ask for: 'MacARTHUR.'

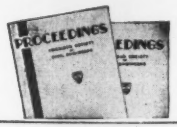
MacArthur
CONCRETE PILE CORP.
18 East 48th St., New York 17, N. Y.
★ ★ ★ ★
New Orleans • Cincinnati • Boston

Atlas

STEEL SYSTEM
of Concrete Form
Speed Construction

SAVINGS of ⅓ to ½ and over 500 uses are reported by contractors everywhere. All steel SPEED forms can be set up, stripped, cleaned, moved and reused in far less time than wood. Interchangeable on job after job, year after year—Walls, slabs, circular tanks manholes, tunnels, etc. For complete facts write Dept. EC.

IRVINGTON FORM & TANK CORP.
20 Vesey Street
NewYork, N.Y.



PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 108.

Summarized in Earlier Issues

67. Model and Prototype Studies of Sand Traps, by Ralph L. Parshall.

68. International Cartography, by Robert H. Randall.

69. Valuation and Depreciation Related to Income Tax, by Maurice R. Scharff.

70. Regime Theory for Self-Formed Sediment-Bearing Channels, by T. Blench.

71. Rectification of the Papaloapan River in Mexico, by Reynaldo Schega.

D-24. Discussion of Paper, **Buckling of Rigid-Jointed Plane Trusses,** by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman.

D-27. Discussion of Paper, **Plasticity of Metals—Mathematical Theory and Structural Applications,** by D. C. Drucker.

D-28. Discussion of Paper, **Retrogression on the Lower Colorado River After 1935,** by J. W. Stanley.

72. Design of Large Coal Bunkers, by Paul Rogers.

73. Health Implications of Air Pollution, by J. J. Bloomfield.

74. Acceptable Standards for Natural Waters Used for Bathing, by Charles R. Cox.

75. Base Course Drainage for Airport Pavements, by Arthur Casagrande and William L. Shannon.

76. Model Tests Using Low-Velocity Air, by James W. Ball.

D-25-K. Discussion of Paper, **Uplift Pressures in Concrete Dams,** by Kenneth B. Keener.

D-29. Discussion of Paper, **Sedimentation Studies at Conchas Reservoir in New Mexico,** by D. C. Bondurant.

D-32. Discussion of Paper, **Effect of Skew Angle on Rigid-Frame Reactions,** by Walter C. Boyer.

Third Notice

77. Buckling Stresses for Flat Plates and Sections, by Elbridge Z. Stowell, George J. Heimerl, Charles Libove, and Eugene E. Lundquist. The results of extensive studies in the buckling of flat unstiffened plates conducted in the field of aeronautics are surveyed. The single plate loadings of compression and shear are considered as well as integral flat-plate loadings of compression only. The buckling stresses are given in the form of a non-dimensional chart for the elastic stress range. (Available August 1.)

78. River Channel Roughness, by Hans A. Einstein and Nicholas L. Barbarossa. The total friction developed on the alluvial bed of a natural river can be described as the sum of a "surface drag" and of a "shape resistance." The surface drag may be determined from conventional friction formulas but the shape or bar resistance is given as a function of the sediment transport. An easily applicable relationship is presented in the form of a graph, from which the shape resistance can be determined. This curve has been derived from a wide variety of measurements in natural rivers and is generally applicable to natural rivers. (Available August 1.)

79. Stage Predictions for Flood Control Operations, by Ralph E. King. The problems relative to the prediction of stages in the lower Mississippi River Valley during flood periods are the subject of this paper. The development of various forecasting techniques and the advantages and limitations of these techniques with respect to use on the Mississippi River are briefly outlined. Methods used by the Stage Prediction Section of the Mississippi River Commission are explained, with emphasis being given to the method used for reaches which are influenced by inflows from major tributaries. Conclusions as to the type of forecasting procedure necessary to obtain reliable stage predictions on the lower Mississippi River are presented. (Available August 1.)

80. Mississippi River Valley Geology Relation to the River's Regimen, by Harold N. Fisk. A brief description of the geology of the alluvial valley of the lower Mississippi River is given and major changes in stream activity are described. The nature and geological development of the alluvial deposits are discussed and the close adjustment between these bed and bank materials and channel characteristics emphasized. Alluvial plain features show that this adjustment has been maintained since the sea reached its present level several thousand years ago. During this period the river has developed and abandoned several meandering courses. The existing Atchafalaya-Mississippi relationships suggests an early stage in the diversion of the river to a new course. (Available August 1.)

81. Petenwell Hydroelectric Project, by E. Montford Fucik. This project, located on the Wisconsin River, involved unusual design problems because of the 100 ft deep sand foundation. The spillway and powerhouse are founded on this sand, and the basic design criteria, as well as the cross sections of the structures are given. Recorded water pressures under the completed structures, and comparisons of model test and prototype scour patterns downstream from the spillway, are shown. The earth dams, built of sand, are described, and recorded seepage lines are compared with the flow net studies. The use of hydraulic spillway gate hoists is also described. (Available August 1.)

Second Notice

82. Pressures in a Shallow Rectangular Bin, by Raymond L. Moore and J. R. Shaw. The estimation of the distribution and magnitude of the pressure forces is important in the design of shallow bins that support granular materials, especially if the bin is subject to impact or vibration. This paper reports and analyzes the results of a series of tests on such materials as wheat, gravel, and cement in loose and vibrated conditions. (Available September 1.)

83. Waterway Traffic on the Great Lakes, by John R. Hardin. The Great Lakes are an important artery of commerce serving an area rich in natural resources and industrial facilities. The shipping channels and harbors

INSTRUCTIONS

1. Papers are to be ordered by serial number. Please keep record of Separates you have ordered to avoid unwanted duplication.

2. Any ASCE member may order a total of 40 copies of papers during the fiscal year ending September 30, 1951, without charge. These may be duplicates of the same paper, separate papers, or a combination of both.

3. Members' accounts will be charged at 25¢ each for orders exceeding 40 copies in a fiscal year. Charges for excess copies or for subscriptions will be included on the 1952 dues bills.

4. Non-members of the Society may order copies of PROCEEDINGS papers by letter with remittance of 50¢ per copy; members of Student Chapters 25¢ per copy.

5. Discussions of each paper, with author's closure, also will be published as a Separate and must be ordered in the same manner as other Separates, except that no charge will be made for the discussions of a paper previously ordered. The order form will list available discussions of papers. Discussions will be numbered to agree with the basic paper.

Standing orders for all Separate papers, including their Discussions, in any calendar year, may be entered at the following annual rates: Members of ASCE, $3.00 (beginning January 1, 1952, $5.00); members of Student Chapters, $5.00; non-members, $10.00, plus foreign postage charge of $.75; libraries, $5.00.

TRANSACTIONS. All PROCEEDINGS papers, with discussions, will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the currently established annual subscription rates.

	To Members	To Non-Members
Leather binding	$4.00	$18.00
Cloth binding	3.00	17.00
Paper binding	2.00	16.00

are splendid examples of the type of improvement developed and maintained by the Great Lakes Division of the Corps of Engineers. Statistics on the magnitude of commerce are given, and the St. Lawrence Seaway Project is discussed. (Available September 1.)

84. Longitudinal Mixing Measured by Radioactive Tracers, by Harold A. Thomas, Jr., and Ralph S. Archibald. Short-circuiting of flow in streams, conduits, lakes, and tanks occurs when some portions of the liquid pass through with velocities considerably greater than the mean velocity. The degree of short-circuiting has an important effect upon the efficiency of water and sewage treatment plants and upon the capacity of streams and lakes for handling pollutional loads. A new tool for assessing the magnitude of longitudinal mixing is use of radioactive tracers. These materials show many advantages over commonly used tracers and make possible precise and sensitive measurements. The paper describes procedures and results and advances the theory of the test. Examples are given indicating the magnitude and effect of mixing. (Available September 1.)

85. Resinous Ion Exchanges in Water Treatment, by William W. Aultman. The application of the newer ion exchanges in the water treatment field is discussed in this paper. The types and uses of many ion exchange materials are summarized and their capacities and costs compared. Demineralization and treatment of industrial process waters are further applications that are described. (Available September 1.)

86. Ground-Water Phenomena Connected with Spreading, by Paul Baumann. Water conservation by the diversion of clear stream flow to off-channel areas is practiced in Los Angeles County, California. This water is caused to percolate into the ground and is added to the ground-water supply. The characteristics and operation of this spreading system are outlined and theoretical expressions derived. The theory is also compared with results of model basin studies. (Available September 1.)

First Notice

87. Sewage Reclamation by Spreading Basin Infiltration, by Ralph Stone and William F. Garber. A field study was completed at two test installations located at Whittier and Azusa, Calif. Sewage effluents and water were spread in basins and percolated to the ground water in order to evaluate the various factors influencing the reclamation process. The Whittier tests were performed in a small basin on a fine sandy loam, while the Azusa work was carried out in a larger basin underlain by coarse gravel soil. Special sampling procedures, hydraulic measurements, soil analyses, bacteriological and chemical tests of the spread fluid, and the percolated effluent were carried out. An evaluation was made of the effects of biochemical oxygen demand, dissolved, oxygen, pH, climate, algae, and chemical pickup on the sewage reclamation process. A simple description and tabulation of the results of all these studies are provided in the write up. The complete hydrological data for the spreading rates obtained at Whittier and Azusa are described. (Available October 1.)

88. Experimental Study of Water Flow in Annular Pipes, by W. M. Owen. Head loss and velocity distribution measurements were made on three annular pipes formed by centrally supporting pipe cores in outer pipes. The fluid used in these tests was water and the range of Reynolds numbers tested was from 4,000 to 700,000. A description is given of the apparatus used and the test procedure. The test results are presented in a series of dimensionless graphs. These results are compared to those of other investigations. A thorough search of the literature revealed eighteen articles on flow in annular pipes that are listed in the bibliography. (Available October 1.)

89. Deflections in Gridworks and Slabs, by Walter W. Ewell, Shigeo Okubo, and Joel I. Abrams. The problems presented in this paper illustrate how horizontal gridworks of rigidly connected beams, with deformation characteristics analogous to those of selected slabs, can be used to develop elastic surfaces under normal loads that are strikingly similar to the surfaces of the original slabs under the same loads. The technique given can be used to determine not only the deflected surface of a slab, but also bending and torsional moments in a slab. This procedure employs an auxiliary force system for controlling vertical displacements of the joints of the equivalent grid system and a single moment and torque distribution process for transmission of the displacement effects. (Available October 1.)

D-30. Discussion of Paper, **Economic Effects of Reservoir Sedimentation,** by William E. Corfitzen. The original paper, published in August 1950, discussed the limits of useful life of reservoirs imposed by sedimentation and gave methods of computing sediment loads, rates, and economics. Discussers are: T. Blench, Martin Maevers, and William E. Corfitzen. (Available October 1.)

D-40. Discussion of Paper, **Construction Technique of Passing Floods Over Earth Dams,** by Andrew Weiss. The original paper, published in October 1950, reported the experience of the author in a new technique of permitting flood flows to pass unhindered over uncompleted earth and rock-fill dams during construction. Discussers are: Cleves H. Howell, Gerard H. Matthes, and Andrew Weiss. (Available October 1.)

D-34. Discussion of Paper, **Lateral Buckling of Eccentrically Loaded I-Section Columns,** by H. N. Hill and J. W. Clark. The original paper, published in September 1950, recorded the results of tests on eccentrically loaded I-section columns and gave the factors involved in the design of a member subject to simultaneous axial compression and transverse bending. Discussers are: Jack R. Benjamin, Jacob Karol, and H. N. Hill and J. W. Clark. (Available October 1.)

D-38. Discussion of Paper, **Hydrology of Mexico,** by Andres García-Quintero. The original paper, published in October 1950, reviewed the factors responsible for the relative scarcity of rainfall in Mexico. Discussers are: Andrew Weiss, Milton O. Schmidt, and Gerard H. Matthes. (Available October 1.)

D-17. Discussion of Paper, **Origin and Significance of Openwork Gravel,** by Allen S. Cary. The original paper, published in May 1950, gave the results of field studies of stream deposits of "openwork" pebbles and boulders without interstitial sand in the Pacific Northwest and the effects of these formations on hydraulic structures. Discussers are: Jacob Feld, A. Casagrande, A. Mayer, H. Cambefort, Hyde Forbes, L. F. Harza, and Allen S. Cary. (Available October 1.)

D-33. Discussion of Paper, **Strength of I-Beams in Combined Bending and Torsion,** by Basil Sourochnikoff. The original paper, published in September 1950, analyzed the stresses in beams due to the interaction of bending and torsion and the influence of deflections on stresses and established allowable stress formulas. Discussers are: Jacob Karol, Melvin W. Jackson, and Basil Sourochnikoff. (Available October 1.)

For the Use of ASCE Members Only

PROCEEDINGS PAPERS ORDER FORM

AMERICAN SOCIETY OF CIVIL ENGINEERS

33 W. 39 ST., NEW YORK 18, N.Y.

Enter my order for Separate PROCEEDINGS Papers which I have circled below:

Paper No. 67 68 69 70 71 D-24 D-27 D-28 72 73 74 75 76
D-25-K D-29 D-32 77 78 79 80 81 82 83 84 85 86 87 88 89
D-30 D-40 D-34 D-38 D-17 D-33

If more than one copy of a paper is desired, indicate here

Name (Please Print) Membership Grade

Address

Signature Date

Professional Services

listed alphabetically by states

EWIN ENGINEERING CORPORATION
Design and Construction
Investigations, Reports, Appraisals, Estimates and Management Surveys, Port Facilities, Foundations, Industrial Plants, Bridges and Structures.
P. O. Box 361 **Mobile 3, Ala.**

PALMER & BAKER, INC.
Consulting Engineers for
Problems of Transportation, Subaqueous Vehicular Tunnels, Rock Tunnels, Utility Tunnels, Bridges, Grade Separations, Highways, Airports, Traffic Studies, Parking Problems, Waterfront & Harbor Structures
Complete Material, Chemical and Soils Laboratories
Mobile, Alabama **Houston, Texas**

JOHN S. COTTON
Consulting Engineer
Hydroelectric, water supply, and multiple purpose projects, flood and erosion control, river basin development planning, dams and their foundations, tunnels, marine structures, valuations, rates.
28 Brookside Drive, San Anselmo, Calif.

DAMES & MOORE
Soil Mechanics Engineering
General Offices
816 West Fifth Street
Los Angeles 17
Regional Offices in
Los Angeles . San Francisco . Portland
Seattle . New York

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations—Reports—Design
Procurement—Field Engineering
Domestic and Foreign
74 New Montgomery St.
San Francisco 5, California

FRED C. SCOBEY
Consultant on hydraulic problems: Water conveyance in pipes, canals, tunnels and flumes, with or without measuring devices. Equivalent sizes, aqueducts of various materials, based on their limitations. Critical review, plans and specs. Suggestions for improving impaired capacity. Know high velocity structures.
1063 Euclid Ave., **Berkeley 8, Calif.**

KAISER ENGINEERS
Division of Kaiser Industries, Inc.
ENGINEER – CONTRACTOR
Investigations – Reports – Valuations
Design – Construction
Twinoaks 3-4600
1924 Broadway **Oakland, Calif.**

O. J. Porter & Company
CONSULTING ENGINEERS
Airports—Highways—Dams
Foundation — Stabilization — Pavements
516 9th St.
Sacramento, Cal.
3757 Wilshire Blvd., Los Angeles, Calif.
415 Frelinghuysen Ave., Newark, N. J.

KIDDER & THOMA
Cadastral Engineers
Large Scale Cadastral Surveys
Riparian Rights, Boundary Locations
Preparation for Trial of Suits
Consultations
Joseph C. Thoma
4811 Blagden Avenue, N. W.
Washington 11, D. C.

DUVAL ENGINEERING & CONTRACTING CO.
General Contractors
FOUNDATION BORINGS
For Engineers and Architects
Jacksonville **Florida**

ALVORD BURDICK & HOWSON
Charles B. Burdick
Louis R. Howson **Donald H. Maxwell**
Consulting Engineers
Water Works, Sewerage, Water Purification, Sewage Treatment, Flood Relief, Power Generation, Drainage, Appraisals.
20 North Wacker Drive, Chicago 6, Ill.

CONSOER, TOWNSEND & ASSOCIATES
Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports, Gas and Electric Transmission Lines
351 East Ohio Street, Chicago 11, Ill.

DeLEUW, CATHER & COMPANY
Consulting Engineers
Transportation, Public Transit and Traffic Problems
Industrial Plants, Grade Separations, Railroads, Subways, Power Plants, Expressways, Tunnels, Municipal Works
150 N. Wacker Drive, Chicago 6, Ill.

GREELEY AND HANSEN
Engineers
Samuel A. Greeley, Paul E. Langdon, Thomas M. Niles, Kenneth V. Hill, Samuel M. Clarke
Water Supply, Water Purification, Sewerage, Sewage Treatment, Refuse Disposal, Industrial Wastes
220 S. State Street, Chicago 4, Ill.

HARZA ENGINEERING COMPANY
Consulting Engineers
L. F. Harza
E. Montford Fucik **Calvin V. Davis**
Hydro-Electric Power Projects
Transmission Lines, System Management, Dams, Foundations, Harbor Structures, Soil Mechanics
400 W. Madison St., Chicago 6, Ill.

SOIL TESTING SERVICES, INC.
Carl A. Metz
Theo. W. Van Zelst
John P. Gnaedinger
Foundation Borings
Field and Laboratory Tests of Soils
Analyses and Reports
Soil Testing Apparatus
4520 West North Avenue
Chicago 39, Ill.

JENKINS, MERCHANT & NANKIVIL
Consulting Engineers
Municipal Improvements Sewerage
Power Development Water Systems
Traffic Surveys Industrial Plants
Flood Control Recreational Facilities
Airports Investigations and Reports
805 East Miller Street
Springfield, Illinois

STANLEY ENGINEERING COMPANY
Consulting Engineers
Airports — Drainage — Electric Power
Flood Control — Industrial Rate Studies
Sewerage — Valuation — Waterworks
Hershey Building, Muscatine, Iowa

HAZELET & ERDAL
Consulting Engineers
Bridges — Foundations
Expressways — Dams — Reports
Monadnock Block
Chicago
403 Commerce Bldg., Louisville
Dixie Terminal Bldg., Cincinnati

EUSTIS ENGINEERING COMPANY
FOUNDATION AND SOIL MECHANICS INVESTIGATIONS
Soil Borings *Laboratory Tests*
Foundation Analyses *Reports*
3645 Airline Highway
New Orleans 20, La.

WALTER N. WHITE & WILLIAM F. GUYTON
Consulting Ground-Water Hydrologists
Ground-Water Supplies
Evaluation, Planning of New Developments; Operational and Maintenance Advice; Legal Proceedings, Artificial Recharge, Induced River Infiltration, Well Interference and Other Ground-Water Problems.
307 W. 12th St. **10 Mississippi Ave.**
Austin 1, Texas **Silver Spring, Md.**

WHITMAN REQUARDT AND ASSOCIATES
Engineers
Sewerage and Water Systems, Airports, Industrial and Power Plants and Other Structures
Reports — Designs — Specifications — Supervision
1304 St. Paul Street, Baltimore 2, Md.

ROBERTSON AND ASSOCIATES
Consulting Engineers
Robert E. Robertson, Jr.
Charles F. Bornefeld **Haydan S. Porter**
Formerly of William & Robertson
Bridges—Structures—Foundations
Industrial Buildings
Baltimore **Richmond**
Maryland **Virginia**

CRANDALL DRY DOCK ENGINEERS, INC.
Railway Dry Docks, Floating Dry Docks, Basin Dry Docks, Shipyards, Port Facilities
Investigation, Reports, Design, Supervision
238 Main St., Cambridge 42, Mass.

IRVING B. CROSBY
Consulting Engineering Geologist
Investigations and Reports
Dams, Reservoirs, Tunnels, Foundations, Groundwater Supplies and Resources
Non-Metallic Minerals
6 Beacon Street
Boston 8, Massachusetts

DUFFILL ASSOCIATES
Consulting Engineers
80 Boylston St., Boston 16, Mass.

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by members of the American Society of Civil Engineers

Your card should be among them.
Write Today For Rates.

Additional Professional Cards On Pages 110 and 111

Professional Services

listed alphabetically by states

FAY, SPOFFORD & THORNDIKE
Engineers
Charles M. Spofford — Ralph W. Horne
John Ayer — Frank L. Lincoln
Bion A. Bowman — William L. Hyland
Carroll A. Farwell — Howard J. Williams
Bridges and Industrial Plants
Water Supply and Sewerage Works
Port and Terminal Works, Airports
Boston — New York

JACKSON & MORELAND
Engineers and Consultants
Design and Supervision of Construction
Reports—Examinations—Appraisals
Machine Design—Technical Publications
Boston — New York

METCALF & EDDY
Engineers
Investigations — Reports — Design
Supervision of Construction
and Operation
Management — Valuation — Laboratory
Statler Building
Boston 16

BENJAMIN S. SHEINWALD
Architectural Consultants
on
Engineering Projects
Design—Supervision—Reports
85 South Street, Boston 11, Mass.

Clark Aerial Survey Corporation
Topographic Maps—Mosaics—
Reconnaissance Strips
E. W. Clark, President
45075 N. Territorial Rd. — Plymouth, Michigan

THE FRANCIS ENGINEERING COMPANY
Consulting Engineers
Water Works, Water Treatment, Sewerage, Sewage Treatment, Flood Control and Drainage, Concrete and Steel Structures, Light and Power. Investigations—Reports—Design—Supervision
Eddy Building, Saginaw, Michigan
Cutler Building, Rockford, Illinois
Johnson Building, Escanaba, Michigan

HITCHCOCK & ESTABROOK, INC.
Lester D. Lee, Associate
Technical Advice
300 Lincoln Building
Minneapolis 1, Minnesota

BLACK & VEATCH
Consulting Engineers
Water—Sewage—Electricity—Industry
Reports, Design Supervision of Construction Investigations, Valuation and Rates
4706 Broadway — Kansas City 2, Mo.

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City 2, Mo. — Cleveland 14, Ohio
P. O. Box 7088 — 1404 E. 9th St.

SVERDRUP & PARCEL, INC.
Consulting Engineers
Bridges, Structures and Reports
Industrial and Power Plant
Engineering
Syndicate Trust Bldg., St. Louis 1, Mo.
220 Bush Street, San Francisco 4, Cal.

A. L. ALIN
Consulting Engineer
5927 N. 24 St.
Omaha, Nebraska
Dams, Hydroelectric Power
Flood Control

AMMANN & WHITNEY
Consulting Engineers
Design — Supervision
Bridges, Buildings, Industrial Plants, Special Structures, Foundations, Airport Facilities
Expressways
76 Ninth Avenue, New York 11, N. Y.
724 E. Mason Street, Milwaukee 2, Wis.

EDWARDS, KELCEY AND BECK
Consulting Engineers
Surveys—Reports—Economic Studies—Transportation, Traffic — Design — Supervision — Management — Port and Harbor Works—Terminals—Expressways — Highways — Grade Separations — Bridges—Tunnels—Water Supply
3 William Street — 250 Park Avenue
Newark 2, N. J. — New York 17, N.Y.

CLINTON L. BOGERT ASSOCIATES
Consulting Engineers
Clinton L. Bogert — Ivan L. Bogert
J. M. M. Greig — Robert A. Lincoln
Donald M. Ditmars — Arthur P. Ackerman
Water and Sewage Works
Refuse Disposal — Industrial Wastes
Drainage — Flood Control
624 Madison Avenue, New York 22, New York

BOWE, ALBERTSON & ASSOCIATES
Engineers
Water and Sewage Works
Industrial Wastes—Refuse Disposal—Municipal Projects
Airfields—Industrial Buildings
Reports—Designs—Estimates
Valuations—Laboratory Service
110 William St., New York 7, N. Y.

JAMES M. CAIRD
Established 1898
C. E. Clifton, H. A. Bennett
Chemist and Bacteriologist
Water Analysis
Tests of Filter Plants
Cannon Building, Troy, N. Y.

L. COFF
Consulting Engineer
Steel saving construction through prestressing concrete and/or structural steel. Design, estimates, erection methods, supervision.
198 Broadway — New York 7, N. Y.

FRANK L. EHASZ
Consulting Engineer
Structures, Bridges, Airports, Parkways
Design, Supervision of Construction
Investigations, Reports
82 Beaver Street — New York 5, N. Y.

HARDESTY & HANOVER
Consulting Engineers
Successors to Waddell & Hardesty
Long Span and Movable Bridges, Hanover Skew Bascule, Grade Eliminations, Foundations, Other Structures, Supervision, Appraisals, and Reports.
101 Park Avenue, New York 17, N. Y.

HALTON and MAURSETH
Consultants on Earthwork and Foundations
Airports, Highways, Tanks and Structures
1060 Broad St. — 4508 Crenshaw Blvd.
Newark 2, N. J. — Los Angeles 43, Calif.

FREDERIC R. HARRIS, INC.
Consulting Engineers
Harbors, Piers & Bulkheads, Drydocks, Foundations, Soil Mechanics, Industrial Plants, Water Supply, Flood Control, Airports, Highways, Bridges, Power, Sanitary & Industrial Waste Disposal
27 William Street — New York 5, N. Y.
3 William Street — Newark, N. J.
Fidelity Phila. Trust Bldg., Philadelphia
Ferry Building — San Francisco

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
Consulting Engineers
Bridges and Structures
Foundations, Highways
Administrative Services
921 Walnut Street — 55 Liberty Street
Kansas City 6, Mo. — New York 5, N. Y.

KNAPPEN TIPPETTS ABBETT ENGINEERING CO.
Ports, Harbors, Flood Control Irrigation Power, Dams, Bridges, Tunnels, Highways
Subways, Airports, Traffic, Foundations, Water Supply, Sewerage, Reports, Design, Supervision, Consultation
62 West 47th Street, New York City

R. M. LEGGETTE
Consulting Ground Water Geologist
Water Supply, Salt Water Problems, Dewatering, Recharging, Investigations, Reports.
551 Fifth Avenue, New York 17, N. Y.

MORAN, PROCTOR, FREEMAN & MUESER
Consulting Engineers
Foundations for Buildings, Bridges and Dams, Tunnels, Bulkheads, Marine Structures, Soil Studies and Tests, Reports, Design and Supervision.
420 Lexington Ave., New York 17, N. Y.
AP. Cor. 614, Caracas, Venezuela

PARSONS, BRINCKERHOFF, HALL & MACDONALD
Engineers
Airports, Bridges, Tunnels, Highways
Traffic & Transportation Reports,
Subways, Foundations, Harbor Works,
Valuations, Power Developments,
Industrial Buildings
Dams, Sewerage, Water Supply
51 Broadway, New York 6, N. Y.

MALCOLM PIRNIE ENGINEERS
Civil & Sanitary Engineers
Malcolm Pirnie — Ernest W. Whitlock
G. G. Werner, Jr.
Investigations, Reports, Plans
Supervision of Construction
and Operations
Appraisals and Rates
25 W. 43rd Street, New York 18, N. Y.

THE PITOMETER CO.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement and Special
Hydraulic Investigations.
New York, 50 Church St.

ALEXANDER POTTER ASSOCIATES
Consulting Engineers
Water Works, Sewerage, Drainage. Refuse Incinerators, Industrial Wastes, City Planning
50 Church Street, New York 7, N. Y.

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Successors to
Elwyn E. Seelye & Co.
Airports, Soil Surveys, Bridges, Stadiums, Docks, Concrete, Highways, Steel, Welding Foundations, Industrial Buildings
101 Park Ave., New York 17, N. Y.

SEVERUD-ELSTAD-KRUEGER
Consulting Engineers
Structural Design—Supervision—Reports
Buildings—Airports—Special Structures
415 Lexington Ave., New York 17, N. Y.

SINGSTAD & BAILLIE
Consulting Engineers
Ole Singstad — David G. Baillie, Jr.
Tunnels, Subways, Highways, Foundations, Parking Garages
Investigations, Reports, Design, Specifications, Supervision
24 State St., — New York 4, N. Y.

FREDERICK SNARE CORPORATION
Engineers-Contractors
Harbor Works, Bridges, Power Plants
Dams, Docks and Foundations
233 Broadway, New York 7, N. Y.
Santiago, Chile — San Juan, P. R.
Havana, Cuba — Lima, Peru
Bogota, Colombia — Caracas, Venezuela

D. B. STEINMAN
Consulting Engineer
BRIDGES
Design, Construction, Investigation, Reports, Strengthening, Advisory Service
117 Liberty Street, New York 6, N. Y.

THE J. G. WHITE ENGINEERING CORPORATION
Design, Construction, Reports, Appraisals
Eighty Broad Street, New York 4, N. Y.

THE AUSTIN COMPANY
Design — Construction — Reports
Plant Location Surveys—Domestic & Foreign Work
16112 Euclid Avenue, Cleveland, Ohio
New York — Detroit — Oakland
Chicago — Houston — Seattle
Los Angeles

Professional Services

listed alphabetically by states

HAVENS AND EMERSON
W. L. Havens C. A. Emerson
A. A. Burger F. C. Tolles F. W. Jones
Consulting Engineers
Water, Sewerage, Garbage, Industrial Wastes, Valuations—Laboratories
Leader Bldg. Cleveland 14, O. — Woolworth Bldg. New York 7, N. Y.

WILSON V. BINGER
Consulting Engineer
Soil Mechanics—Foundations
Earth Structures
222 W. Rayen Ave., Youngstown 2, Ohio

ALBRIGHT & FRIEL, INC.
Consulting Engineers
Francis S. Friel
Water, Sewage and Industrial Waste Problems, Airfields, Refuse Incinerators, Dams, Flood Control, Industrial Buildings, City Planning, Reports, Valuations—Laboratory
121 So. Broad Street, Philadelphia 7, Pa.

GANNETT FLEMING CORDDRY & CARPENTER, INC.
Engineers
HARRISBURG, PA.
Water Works, Sewage, Industrial Wastes & Garbage Disposal—Roads, Airports, Bridges & Flood Control, City Planning, Traffic & Parking, Appraisals, Investigations & Reports.
Branch Offices
Scranton, Pa. — Pittsburgh, Pa.
Daytona Beach, Fla. — Havana, Cuba
Medellin, Colombia, S.A.

MICHAEL BAKER, JR., INC.
The Baker Engineers
Civil Engineers, Planners, and Surveyors
Airports—Highways—Sewage Disposal Systems—Water Works Design and Operation—City Planning—Municipal Engineering—All Types of Surveys
Home Office: Rochester, Pa.
Branch Offices:
Jackson, Miss. — Harrisburg, Pa.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Surveys—Design—Supervision
Domestic and Foreign
Industrials and Utilities
412 Washington Street, Reading, Pa.

HUNTING, LARSEN & DUNNELLS
Engineers
Industrial Plants — Warehouses — Commercial Buildings—Steel and Reinforced Concrete—Design—Supervision—Reports
1150 Century Bldg., Pittsburgh 22, Pa.

JUSTIN & COURTNEY
Consulting Engineers
Joel B. Justin — Neville C. Courtney
Dams and Power Problems
Hydro Electric Developments
Foundations
121 S. Broad St., Philadelphia 7, Pa.

MODJESKI AND MASTERS
Consulting Engineers
F. M. Masters
G. H. Randall — J. R. Giese
C. W. Hanson — H. J. Engel
Design and Supervision of Construction
Inspection and Reports
Bridges, Structures and Foundations
535 Fifth Ave. New York, N. Y. — State St. Bldg. Harrisburg, Pa.

MORRIS KNOWLES, INC.
Engineers
Water Supply and Purification
Sewerage and Sewage Disposal
Valuations, Laboratory, City Planning
1312 Park Bldg., Pittsburgh 22, Pa.

R. C. JOHNSON
Consulting and Designing Engineer
1226 Bull St., Columbia 1, S. C.

THE McPHERSON COMPANY
Engineers and Architects
Design — Power Plants
Supervision of Construction — Reports
Industrial Plants — Appraisals
Greenville, South Carolina

GREER & MCCLELLAND
Consulting Foundation Engineers
Foundation investigations — engineering soil testing — undisturbed sampling and core drilling.
2649 N. Main — Houston 9, Texas

LOCKWOOD & ANDREWS
Consulting Engineers
Airports, Paving, Industrial Plants, Drainage & Sewerage, Water Supply, Soils & Foundations, Power Plants, Structures, Harbor Works, Valuations
Reports—Design—Supervision
Houston, Texas

ENGINEERING SERVICES
Consulting Engineers
S. D. Caplan & Associates
Water Supply — Sewage Disposal
Appraisals — Mapping
Planning — Foundations
Specifications
Cont'l Bank Bldg. Salt Lake City

More and More Members of the Society are using this Service. Is Your Card Here?

ENGINEERING as a CAREER

A MESSAGE TO YOUNG MEN, TEACHERS AND PARENTS

This pamphlet has been prepared as an educational guide, in order to give something of an introductory insight into the profession of engineering. It is dedicated to the coming generation of engineers and to the constructive contributions which they will make to the life and culture of mankind. Contents of the booklet have been divided into three main parts: The Scope of Engineering; Principal Branches of Engineering; and References to Vocational Guidance Literature.

PRICE $0.15 ($10.00 per 100)

ORDER NOW—USING THE COUPON BELOW

Engineers' Council for Professional Development
29 West 39th Street — New York 18, N. Y.

Please forward a copy of "Engineering as a Career." Payment is enclosed.

NAME.....

ADDRESS.....

CITY.....

If you are an engineering executive, engineer, teacher or student—

You have a stake in the Engineering Profession

The SECOND MILE

by W. E. Wickenden

["*Whosoever shall compel thee to go one mile—go with him twain.*"]

Epitomizes for you—
your staff
your students

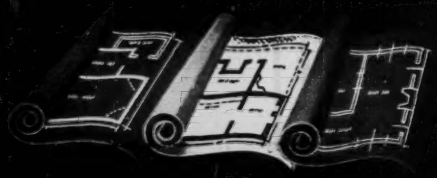
1. Ideals for the professional life
2. Rules for the engineer to live by
3. What engineers must do to make engineering a profession

5000 words of simple useful philosophy about the needs and aspirations of the Engineer. An understanding of "The Second Mile" is essential to professional maturity.

Single copy 15 cents 15 or more 10 cents a copy

Engineers' Council for Professional Development
29 West 39th Street — New York 18, N. Y.

NOW! BY ANY PROCESS!



SHARPER *white or blueprints!*

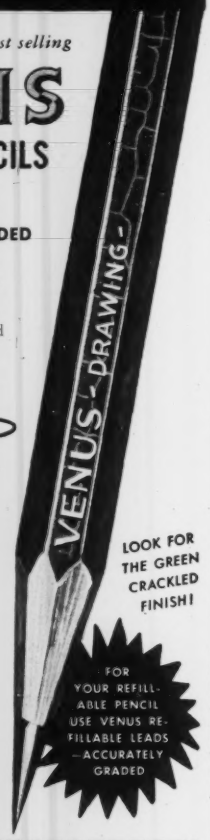
with the world's finest, largest selling

VENUS
DRAWING PENCILS

- **ACCURATELY GRADED** —in 17 degrees
- **STRONGER** — the lead is *Pressure-Proofed**
- **SMOOTHER** — the lead is *Colloidal* processed*

*Exclusive Venus patent

Uniform lines in weight and tone. Opaque lines for sharp, clear reproduction. Strong points, smooth in action. No smudge; no ghosts from erasures. There's the right degree for your favorite tracing papers. The result: sharper prints—*by any process!*



LOOK FOR THE GREEN CRACKLED FINISH!

FOR YOUR REFILLABLE PENCIL USE VENUS REFILLABLE LEADS —ACCURATELY GRADED

TRY Venus on your papers. **Then see the print quality. Get Venus** *Technical Test Kit* with pencils in the degrees you want . . . . . ***FREE!***

AMERICAN PENCIL CO., HOBOKEN, N. J.

AMERICAN PENCIL COMPANY
Hoboken, New Jersey Dept. CE 951

Please send me free Venus *Technical Test Kit* with two Venus Drawing Pencils in these degrees: ( ) ( ).

Name .....

Company .....

Street .....

City ..... *State* .....

INDEX TO ADVERTISERS

AERO SERVICE CORPORATION 20
ALBERT PIPE SUPPLY CO., INC. 82
AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS 96
AMERICAN PENCIL COMPANY 112
AMERICAN PIPE & CONSTRUCTION CO. 85
AMERICAN STEEL & WIRE COMPANY 93
JACK AMMANN MAPS 104
ARKWRIGHT FINISHING COMPANY 83

BETHLEHEM STEEL COMPANY 3
BLUDWORTH MARINE, DIV. OF NATIONAL SIMPLEX-BLUDWORTH, INC. 103
BOEING AIRPLANE COMPANY 90
BROWN & BROWN, INCORPORATED 106

CAST IRON PIPE RESEARCH ASSOCIATION . . . . 4 and 5
CATERPILLAR TRACTOR CO. 13
CEMENT GUN COMPANY 102
CHICAGO BRIDGE & IRON COMPANY 19
CLIPPER MANUFACTURING CO. 87
COLORADO FUEL & IRON CORPORATION, WICKWIRE SPENCER STEEL DIVISION 15
COLUMBIA STEEL COMPANY 93
THE COMMERCIAL SHEARING & STAMPING CO. 99
COMPLETE MACHINERY & EQUIPMENT COMPANY . . . 106
CONCRETE REINFORCING STEEL INSTITUTE 12

DRILLED-IN CAISSON CORPORATION 96

EASTMAN KODAK COMPANY . . . . . 3rd cover
THE EBERHARD FABER PENCIL CO. 97

GARDNER-DENVER COMPANY 81
GENERAL ELECTRIC CO. 75
W. & L. E. GURLEY 79

HAMILTON THOMAS CORPORATION 14
JOHN HENSCHEL & CO., INC. 101
HYSTER COMPANY 21

IMPERIAL PENCIL TRACING CLOTH 103
INTERNATIONAL HARVESTER COMPANY . . . . . 8 and 9
IRVING SUBWAY GRATING CO., INC. 105
IRVINGTON FORM & TANK CORP. 106

JOHNS-MANVILLE CORPORATION . . . . . 10 and 11
JOHNSTON PUMP COMPANY 82

KERLOW STEEL FLOORING CO. 91
KEUFFEL & ESSER CO. . . . . 16, 17 and 103
WM. F. KLEMP COMPANY 97
KOPPERS COMPANY, INC. 101

LAYNE & BOWLER, INCORPORATED 98
LEFAX 104
LEUPOLD & STEVENS INSTRUMENTS 95
LOCK JOINT PIPE COMPANY . . . . . 4th cover
LONE STAR CEMENT CORPORATION 22

MACARTHUR CONCRETE PILE CORP. 106
McGRAW-HILL BOOK COMPANY 105
MORETRENCH CORPORATION 103

PHILADELPHIA GEAR WORKS INC. 1
PITTSBURGH-DES MOINES STEEL CO. 77
PORTLAND CEMENT ASSOCIATION 2
PRESSURE CONCRETE COMPANY 105
PROPORTIONEERS, INC. 6

RAYMOND CONCRETE PILE CO. . . . . 2nd cover

SERVICISED PRODUCTS CORPORATION 96
SIMPLEX VALVE & METER CO. 84
A. O. SMITH CORPORATION 87
S. MORGAN SMITH COMPANY 7
SOLVAY SALES DIVISION, ALLIED CHEMICAL & DYE CORPORATION 91
SPENCER, WHITE & PRENTIS, INC. 99
SPRAGUE & HENWOOD, INC. 104
J. S. STAEDTLER, INC. 98

TENNESSEE COAL IRON & RAILROAD COMPANY . . . 93

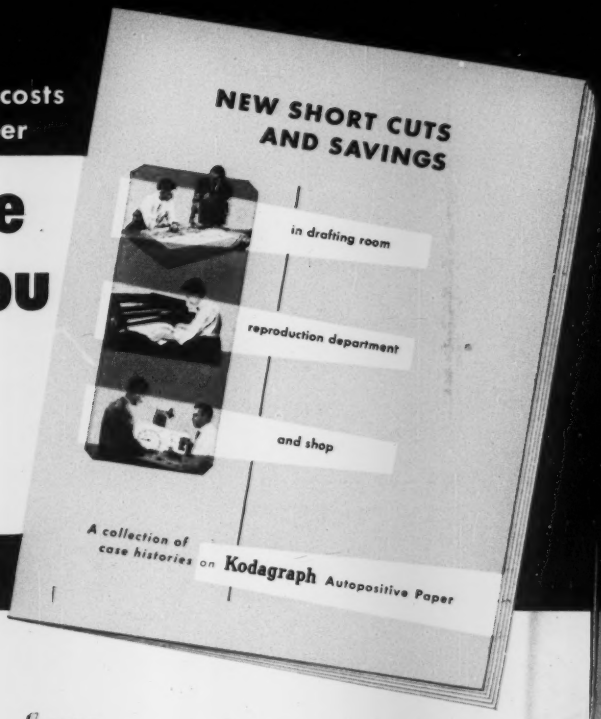
U. S. PIPE & FOUNDRY COMPANY 24
U. S. STEEL CORPORATION 93
U. S. STEEL EXPORT COMPANY 93

WARREN FOUNDRY & PIPE CORP. 94
WARREN KNIGHT COMPANY 91
WESTERN WATERPROOFING CO. 104
DAVID WHITE COMPANY 92
WICKWIRE SPENCER STEEL DIVISION OF THE COLORADO FUEL & IRON CORPORATION 15
HENRY WILD SURVEYING INSTRUMENT SUPPLY CO. 90
JOHN WILEY & SONS, INC. 95
WORTHINGTON PUMP & MACHINERY CORP. 18

YUBA MANUFACTURING CO. 86

Thousands of companies are cutting costs with Kodagraph Autopositive Paper

...this new, free booklet shows you *how*


NEW SHORT CUTS AND SAVINGS
in drafting room
reproduction department
and shop
A collection of case histories on Kodagraph Autopositive Paper

Here you'll find a selection of case histories illustrating the many different ways industry is using Kodagraph Autopositive Paper—the low-cost photographic intermediate material...which gives you positive copies *directly;* which can be handled in room light...and printed with existing equipment.

Interesting and Profitable Reading

how the American Brake Shoe Company (Kellogg Div.) . . . broke the bottleneck in reproducing blueprints.

how the Cleveland Crane and Engineering Company... saves creative drafting time.

how the Cooper-Bessemer Corporation . . . reduced the possibility of costly reading errors in the shop.

how the Crompton & Knowles Looms Works . . . simplified its engineering drawing files.

how the Ford Motor Company . . . saves $75,000 per year in retracing costs.

how the Heald Machine Company . . . produces photographic intermediate prints at a new low cost.

how the Ingersoll-Rand Company (Compressor Div.) . . . salvages old drawings . . . employs ingenious short cuts in drafting.

how the M. W. Kellogg Company . . . assures photolasting intermediates for its overseas branches.

how the State of Virginia, Dept. of Highways . . . saved thousands of man-hours in its drafting room.

how Palmquist & Wright . . ."insures" its drawings at low cost.

Valuable information for every engineer, draftsman, and print-room supervisor

On every page of this concisely written, well-illustrated booklet, you'll find factual information which can be converted readily into savings in your company.

So write today for your free copy of "New Short Cuts and Savings.".

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

MAIL COUPON TODAY

MAIL COUPON FOR FREE BOOKLET

EASTMAN KODAK COMPANY, Industrial Photographic Division, Rochester 4, N. Y. 93

Gentlemen: Please send me a copy of your illustrated booklet, "New Short Cuts and Savings."

Name_____ Position_____

Company_____

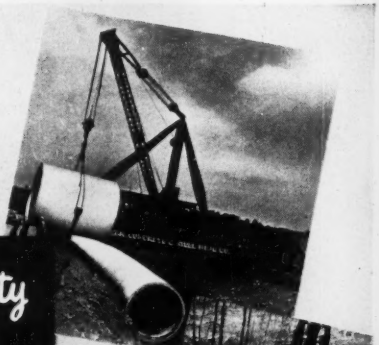
Street_____

City_____ Zone_____ State_____

Kodak TRADE-MARK

NEW YORK CITY

BOSTON MASS.



For Utmost Security

IMPORTANT AMERICAN CITIES INSTALL

LOCK JOINT

CONCRETE PRESSURE PIPE

HARTFORD CONN.

PORTLAND ME.

More than anyone else, those responsible for supplying water for domestic or industrial use appreciate the value of pipe lines which provide these four freedoms:

Freedom from:

- ★ Rupture or blow-out
- ★ Maintenance and repairs
- ★ Loss of carrying capacity
- ★ Corrosion or deterioration

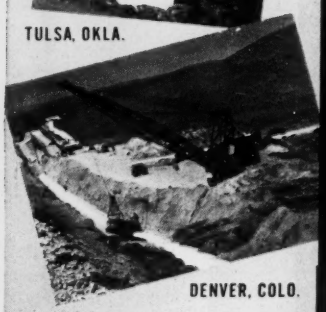
The water works man who installs Lock Joint Concrete Pressure Pipe will have trouble-free pipe lines. The careful design of Lock Joint Pressure Pipe does not permit blow-out or rupture; its dense concrete walls are immune to tuberculation, corrosion or electrolytic attack; and its useful life has been estimated by competent hydraulic engineers at more than 100 years. Among Lock Joint's strongest supporters are the water works officials who have installed this type of pipe and who point to it as the most economical in their systems.

• • •

If you are quality minded yet cost conscious, specify Lock Joint Pressure Pipe, secure in the knowledge that you are receiving the best value the pipe industry can provide.

TULSA, OKLA.

NORFOLK, VA.



DENVER, COLO.

KANSAS CITY, MO.

LOCK JOINT PIPE COMPANY

Est. 1905

P. O. Box 269, East Orange, N. J.

Pressure Pipe Plants: Wharton, N. J., Turner, Kan., Detroit, Mich.

BRANCH OFFICES: Cheyenne, Wyo. Casper, Wyo. • Denver, Col. • Kansas City, Mo. Valley Park, Mo. • Wichita, Kan. • Chicago, Ill. Rock Island, Ill. • Kenilworth, N. J. • Hartford, Conn. • Tucumcari, N. Mex. • Tulsa, Okla. Oklahoma City, Okla. • Beloit, Wis. • Hato Rey, P. R.

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.